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• Drilling and Producing • Refining and Gas Processing • Oil and Gas Pipelining

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Here It Is--A New Era of Promise!

Around the globe there is a gradual awakening to the fact that the privately owned and operated petroleum industry is more capable of finding and developing oil than government-owned monopolies.

Events in far-flung places on the earth are creating a more favorable climate for an alert and progressive oil industry. There has been no nationalization of an oil industry since Iran's; instead Turkey reversed the act and denationalized its oil resources, inviting foreign companies to come in. There has been in the last year no tightening of petroleum laws in the free countries of the world; on the contrary, progress has been made in liberalizing the petroleum laws of several nations.

In Washington, controls were dropped so quickly the industry was almost staggered. There was the fresh faith of a new Administration to spur a free economy. For the first time in years some one besides the government was going to explore Alaska—the new Secretary of Interior signed leases with Phillips and others to explore the Far North territory.

What had changed the trend of several decades and turned the free world toward freer economy? Why this series of better breaks for the privately owned petroleum industry?

The big reason is the petroleum industry's own record. It is hard for the watching world to miss the shining examples of Venezuela, Canada, Saudi Arabia, Kuwait, Colombia, Peru and others, which had reaped rich rewards from oil revenue without encroachment upon political affairs. Surely, thought others, these nations have nothing to regret and have gained much. They have lost no freedom and have oil resources developed at no cost to themselves.

To carry on operations the oil industry brings to odd corners of the earth great trucks and tractors, rigs and dredges. Excitement flavors the air. Then come new roads and sanitation, training courses and good jobs, hospitals and health clinics, schools and education, agricultural and economic research. Living standards lift a bit. Life assumes more importance. All these things are not lost upon the neighbors, who are likely to look upon a not-so-successful government monopoly with jaundiced eye.

Another reason for a more favorable climate is that more petroleum companies are going into foreign operations. More companies trying to sell themselves help improve relations with the whole industry, which is an important factor in competitive enterprise.

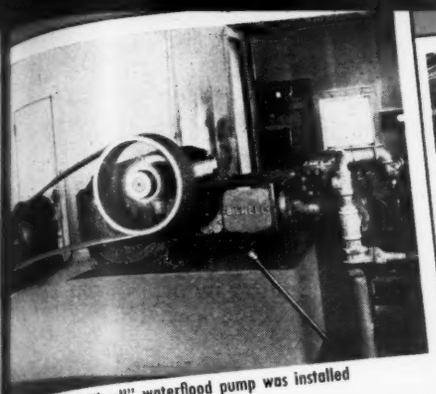
Oddly enough the Iran nationalization contributed to the reaction. On one hand is the reluctance of the world oil industry to handle expropriated oil and the swallowing up of Iranian oil markets by the extensile oil industry. On the other, was the quick response of concession holders to demands for higher royalties by countries taking advantage of the threat in Iran's example.

There is a new confidence, also, on the part of the industry in its ability to satisfy demand. The specter raised by the "running out of oil" alarmists has been quietly buried. When attending the American Institute of Mining and Metallurgical Engineers Convention in Los Angeles, Michael L. Haider, retiring president of AIME and deputy coordinator of producing activities for Jersey Standard, condensed this idea to one sentence: "America's millions of automobiles will be running on atomic energy long before this country runs out of gasoline." This goes for the rest of the free world.

But the oil industry cannot stop to bask in this better environment. It must grapple with the problem of keeping supply and demand in balance in the huge yet sensitive world oil operation. Without ample supply in reservoir storage to meet demand increase and a mobile distribution system to reach every corner of the earth, there is danger of shortage. This would bring hordes of economic planners to shackle the industry and consumers with rationing, price controls, and eventually government control of the industry, not only in the U. S., but in many other countries.

There is always pressure on companies to cash in on production to finance expansion and pressure on companies in foreign operations by governments eager for the larger royalties derived from higher production. It will take industry diplomats of high order to bring the short and long range opponents to some elastic middle ground where production safely meets demand and flexibility is retained. An expanded marketing division may be part of the answer to the problem. The solution must come if the industry is to meet the opportunity for expansion.

For this is the time we've been waiting for — this is the time of green lights for the modern free petroleum industry — a time for vision and courage, common sense and the will to go forward in this new era of promise. — E.A.



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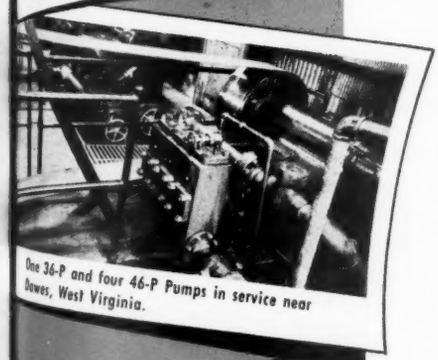
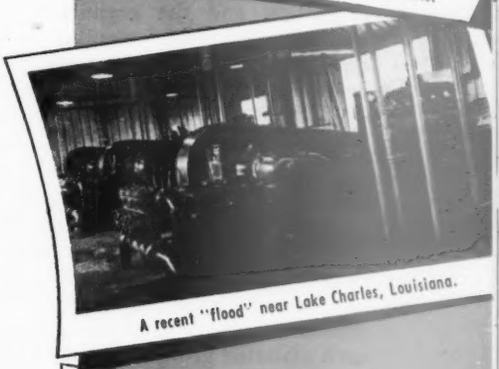
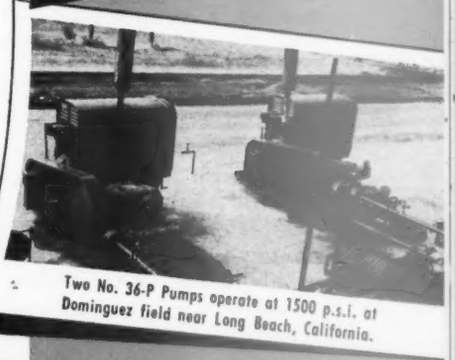


One 36-P and four 46-P Pumps in service near Dowes, West Virginia.



A recent "flood" near Lake Charles, Louisiana.

A recent "flood" by Buffalo Oil Company near Wewoka, Oklahoma.



Two No. 36-P Pumps operate at 1500 p.s.i. at Dominguez field near Long Beach, California.

COLORED portions of this little map show the extent to which waterflood operations have expanded since the Bradford "boom days" of 1935.

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With the EDITORS.....

Unions for Engineers?

Trend toward unionization of every type worker in every level of education, industrial, or commercial activity is spreading even to engineers, chemists, and similar professional lines—lines that heretofore have been considered by most informed people as beyond the pale of labor union classification. Most recent development is that of Engineers and Scientists of America, ESA, considered by its leaders as a dyed-in-the-wool trade union. It appears to be organized in typical fashion, "to promote economic, social, and professional welfare of its members," including collective wage or salary bargaining in the conventional and well-known manner: Its first convention has been held in Los Angeles in February.

The new union has its beginnings in the (proposed) merger of two other organizations, one the Pacific-Coast-born National Professional Association of Engineers, Architects and Scientists (NPA), and its Eastern counterpart, Council of Engineering and Scientific Employees (CESE). Constitutional convention in Chicago a year ago, adopted by-laws that say it will be an activated outfit when eight local groups ratify these laws and its constitution, and this happened December 1952.

The avowed purpose of the union is to enroll all non-supervisory chemical engineers and chemists and to present a united front in bargaining with employers, legislative bodies, frankly referred to as "lobbying," and other functions considered suitable for such a body including a clearinghouse for information and the organization of new member units. No individual memberships will be held, the unit being the affiliated group. No affiliation with any of the major union combines, AFL or CIO, is considered at present. Strong efforts are to be made to improve the salary positions of members of affiliated groups. Largest advance made recently is the affiliation of 4500 workers in Western Electric.

ESA also wants technical employees included under a liberalized Fair Labor Standards Law. An organization publication for the union is under plan, as well as to assemble a staff of full-time paid workers in the central office. Dues will be levied on each affiliated group at a rate of about $4 per group member. Even a union representative to be kept at Washington during Congressional sessions is contemplated.

Present officers are Joseph Amann of Minneapolis, president, and vice president John E. Taft of Sperry Corporation at New Hyde Park, New York.

The great mass of engineers and chemists must and will study rather carefully the details of the purpose of this new organization, the connotation of joining with a group that has so many potential possibilities as has a "labor" union. Is it a labor union to improve the engineer's status without hampering his freedom of action to pursue his own professional course on his own capabilities? Will it throttle him to make a treadmill worker of him, unable to rise above, held up to prevent his dropping below, the common level?

Two points stand out: Such an organization could be taken over by the big combines, if the membership could be hoodwinked into believing they would get more benefits, and the outfit would thus lose its independent identity. More to the concern of the traditionally independent-minded technical man is the fact that unionization reduces all to a dead level, in a majority of cases, they say. This for the intelligent, aggressive technologist will mean small benefits at the cost of individual advancement in line with the capabilities of the superior individual. The great body of engineers and chemists will "watch the thing over" very carefully before joining the ranks.—A. L. F.

Pipe Line Welding Standard

A much needed guide for proper procedures to follow in welding pipe lines in the field has recently been published by the American Petroleum Institute under the title of "Tentative Standard for Field Welding of Pipe Lines." Although published by API, the standards were formulated by committees composed of representatives of the American Gas Association, National Electric Manufacturers Association, Pipe Line Contractors Association, and the American Petroleum Institute.

The new standard has as its purpose the procurement of highest quality welds by specifying approved procedures, materials, and equipment.

The need for a "standard" for pipe line welding has been a subject of discussion for many years. It was not until May, 1949, however, that anything concrete was done about it. This was at French Lick, Indiana, at the Natural Gas Conference. The proposal there met with active response and resulted in a general group meeting in Chicago in November, 1949. This meeting was attended by representatives of pipe line operating companies, contractors, and equipment manufacturers. At that time a resolution was adopted asking that the American Petroleum Institute and the American Gas Association jointly sponsor a group to study field welding and related subjects with a view to arriving at a general specification for all field pipe line welding.

Upon acceptance of this sponsorship by API and AGA, a formal committee was organized known as the API-AGA Joint Committee on Oil and Gas Pipe Line Field Welding Practices. Three subcommittees were appointed, consisting of four members each, these to represent API, AGA, and the Pipe Line Contractors Association. Each of the subcommittees prepared separate specifications and met to combine their ideas, and the combined specification was sent to members of the Joint Welding Committee for comment. Several meetings were held by the joint committee to review and revise the draft and the fourth draft finally was accepted for distribution to the sponsor groups. Comments and criticisms were then reviewed and discussed by the Joint Welding Committee and a fifth draft made. In this form it was submitted to the Joint Welding Committee and the subcommittees for ballot ratification, and was found generally acceptable.

These details concerning the many steps necessary to put the standard into acceptable form are given to reveal the vast amount of work the project required. With such painstaking attention to details it seems assured that the pipe line industry now has a code or plan to follow that will ably fill the purpose for which it was intended—production of highest quality welds.—F. H. L.

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HIGHLIGHTS IN OILDOM

Steel Plentiful in 1954

Spokesmen for the Government have assured oil men that in 1954 they should be able to get all the steel casing and tubing they need. According to a report by the Petroleum Administration for Defense and the National Production Authority annual production of steel by 1955 will reach as high as 2,747,000 tons, about 50 per cent above the 50-51 level. Until next year, however, oil men were warned they would have to put up with high-priced conversion and foreign production.

Domestic drillers should be able to drill about 50,000 wells in 1955, J. Ed Warren, PAD deputy administrator estimated, adding that annual well completions for 1953 through '55 won't top that rate "under present economic incentives." PAD added that it did not believe the oil industry would meet its goal, set last year, of 55,000 wells during 1953.

States Want Entrance in IOC

Growing significance of the Interstate Oil Compact is borne out by the fact that three states have introduced bills to their respective legislatures for affiliation with the compact. Earl Foster, secretary of the Compact Commission, reported a bill has been introduced in Wyoming for affiliation, bearing four signatures. Previous sessions turned down such measures. North Dakota is seeking a concurrent resolution and appropriation for participation in the Compact, and Nebraska house bill asks the right of the governor to declare membership in the Compact.

New Recovery Agent Used

Engine exhaust gas is being injected in the Allegheny County, New York, oil field, in an effort to increase crude production. A project of the Pennsylvania Grade Crude Oil Association's production research department, test is being carried out on the Thornton Company lease, under the direction of Dr. J. N. Breston, director of the department's laboratory in Bradford. Theory behind experiment is that gas will replace and make floodable some of the oil that would be unrecoverable by conventional water-flooding of the oil bearing formations.

Higher Severance Tax

The Mississippi state legislature has been asked to approve a bill increasing the severance tax on daily crude oil production from 6 to 8 per cent to provide funds to be used in equalizing the state's white and Negro schools. Gardner Green, producer and president of the Mississippi-Alabama division of the Mid-Continent Oil and Gas Association has reported that the higher severance tax would be both excessive and oppressive, placing an excessive burden upon the state's petroleum industry.

Texas Seeks Pipe Lines Tax

Two bills have been introduced in the Texas legislature aimed at natural gas pipe lines. One group which opposes an increased gasoline tax, introduced a proposed tax of $60 per horsepower on natural gas compressors, estimating that the bill would net $60,000,000 annually.

Another bill would levy a processing tax of one cent per 1000 cu ft on natural gas. Sponsors claim this would replace or supplement the gas-gathering tax of 9/20 of one cent per 1000 cu ft now under court attack.

Oil Imports Under Attack

Bryan W. Payne, president of the Texas Independent Producers and Royalty Owners Association, has expressed the belief that importers should absorb part of any "adjustment" in oil market demand. In answer to a query by the Texas Railroad Commission, Payne declared that importers expect an increase of about 5 per cent in U. S. domestic demand this year, adding, that the excess in crude and products already in storage will absorb most of that. He declared that importers "must either cut back imports or acknowledge publicly that their promises not to supplant domestic production are worthless." Payne also declared that exploration and drilling in the U. S. will suffer "unless imports are made subject to the same market demand adjustments as domestic production."

Oil Earnings Under 1951

Majority oil producers in the United States report that profits were not as great in 1952 as in 1951, but for most companies it was the second most profitable year in the history. Chase National Bank has reported that when its survey of 30 oil companies in 1952 is complete income was expected to total $2,015,000,000, about 3.6 per cent under 1951's total. Although profits were lower, demand was higher last year. Total demand was estimated at 7,700,000 bbl daily, 3.4 per cent above 1951 daily requirements. Cost of production, high maintenance costs, and increased wages were responsible for a slight dip in profits.

Oil Bonus Set Up

A bonus of $100,000 may be awarded the first wildcatter who brings in an oil well producing as much as 50 bbl of oil per day in South Dakota. A bill has been introduced to the state legislature appropriating that amount, in an effort to offer enough incentive to the oil man to carry out an intensive search for oil in that state. South Dakota previously offered a cash bonus for a good discovery well in the state, but although a number of wells have been completed in the Black Hills region, none qualified for commercial discovery within the qualifications of the bonus offers.

Coal Girds for Battle

The bituminous coal industry has called upon Congress to halt the rising tide of residual fuel oil flowing into the Atlantic Seaboard from foreign refineries. Tom Pickett, executive vice president, National Coal Association, announced that an appeal for a quantitative limitation on residual fuel oil imports was voiced in a resolution adopted by the Association's Executive Committee in a special meeting in Washington.

Declaring that such imports inflict "incalculable damage" on the bituminous coal industry, the resolution pointed to the need for maintaining the coal industry at maximum strength as essential to the nation.

Oil Prices Seen Steady

Oil and government officials assure the public that it won't be belted with big price jumps now that most controls have been removed. Fractional increases will be noticeable along the California-Arizona-Nevada-Oregon region, it is believed, but predications are that prices for the rest of the nation will remain at approximately the same levels.

Phillips Will Drill in Alaska

As soon as weather permits, Phillips Petroleum Company will send geological field parties into the Katalla-Yakataga area of Alaska where it has newly acquired operating rights on one million acres of vacant unappropriated public domain lands of the United States. Acreage extends for approximately 120 miles along the shore of the Gulf of Alaska between Juneau and Anchorage. Its western boundary is 50 miles east of Cordova. It was announced in Washington, D. C., last week by Secretary of the Interior, Douglas McKay, that he had approved a contract with Phillips for oil exploration and development in this area, and that he had issued to others more than 500 leases covering this acreage.

New Tidelands Debates

Although the 15-year-old tidelands dispute between the states and the Federal Government may not be completely settled this year some decision is eminent, Congressmen believe. Attorney General Brownell touched off several heated arguments recently when he ruled informally that the Truman order, issued in January, did not actually set up a Naval oil reserve on submerged offshore lands. He stated that Truman's order only transferred ownership of the offshore lands to the Navy Department from the Interior Department.

A bill presented by Senator Holland has been presented to the Senate Interior Committee, that would restore to the states clear title to oil and natural resources within historic state boundaries—3 miles seaward of low water except for Florida and Texas, whose boundaries extend 10½ miles.

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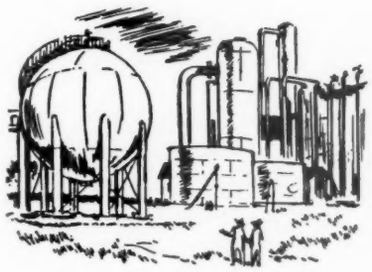

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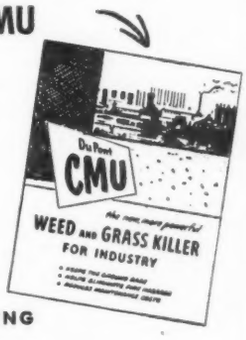

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Up in our old stamping ground, Calgary, where the Chinook winds waft their winter warmness and where many years ago Chester Elliott sneaked a firecracker into the mashed potatoes and gave us our first spud shower, there is an interesting geological chap holding forth in behalf of Trinidad Leaseholds of Canada, Ltd., to wit, Hans Heinrich Suter. Born in Kolliken, Switzerland, Heinrich (he uses his second given name because the Alps are literally swaming with Hans Suters—all gelogists, too) attended the universities of Tubingen, Germany; Basle and Zurich, Switzerland; and College de France, Paris, specializing in the earth sciences and finishing with a Ph.D. in mineralogy, petrography, and geology, from the University of Zurich.

The poor chap seems from the beginning to have been doomed to a multisyllabic existence for immediately after this protracted exposure to the complex verbiage of the geo-sciences he went to Peru as a member of Bataafsche Petroleum Maatschappij and, of course, had to learn to say that. Thence he migrated to Venezuela, Bolivia, Trinidad, and Canada, continuously engaging in the more technical phases of exploration and exploitation. He joined Trinidad Leaseholds as chief geologist in 1939 and is currently assistant to the president, and research geologist, in the Canadian affiliate. In his own employee publications, Heinrich has occasionally written articles that carry the ingenious byline, H_2S (Hans Heinrich Suter).

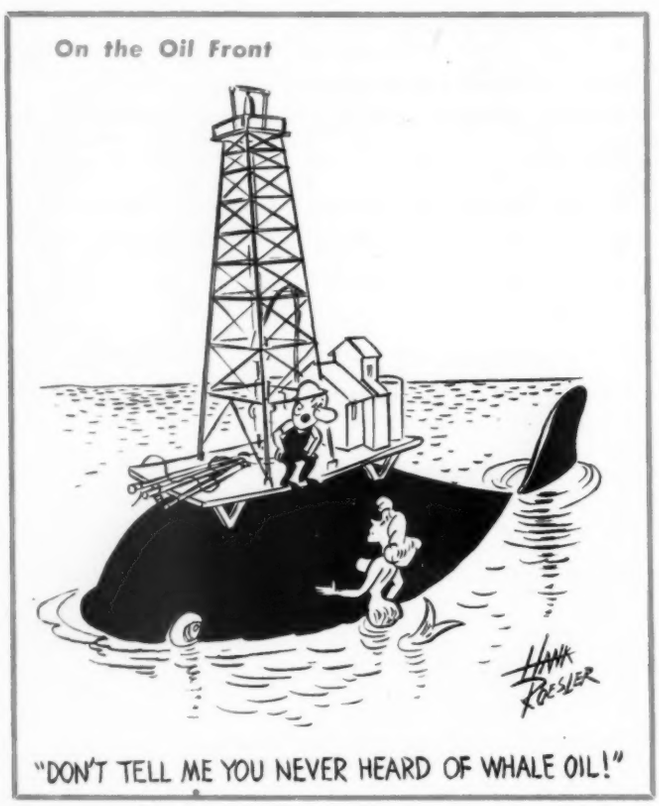
He counts one of the greatest successes of his western migration, the acquisition of an American wife; he thinks that some day the communists will hate themselves and then it will be unanimous, and he finds enjoyable diversion in color photography and carpentry so that he has a permanent record of both what he sees and what he saws.

Great Lakes O. & C. Hosts Celebrities

The Petroleum Club of Los Angeles in the new Statler Hotel was the scene recently of a lunch meeting that was attended by some very distinguished people from scattered parts of the country. The gathering was a completely informal affair, called by Charlie Hale, president of Great Lakes Oil and Chemical Company, to provide a few moments of relaxation for the visiting celebrities, most of whom were oil men either by investment or by actual participation in management.

Among them were such well known figures in oil and finance as R. E. "Dick" Bishop, Great Lakes director and noted New Yorker, now wintering among the wistarias in Sierra Madre, California; Gerald Shipman, another equally reputable New Yorker; Louis Stirling, also a director of the firm and a member of Betts-Borland and Company, investment brokers, Chicago; R. M. Olds of Olds Oil Corporation, a Great Lakes subsidiary in Casper, Wyoming; John Atkins, treasurer of Great Lakes Oil and Chemical Company, Grand Rapids, Michigan; C. Edwin Mercier, prominent banker and broker of the firm of Strauss Blosser and McDowell, Detroit, Michigan; W. H. Geis, Los Angeles consultant and independent operator; Fred Tanner, California Bank, Los Angeles; Ernest Bysshe and Milton Barratt, independent operators and former owners of Cleveland Oil Company which not long ago was purchased and absorbed by Great Lakes O & C.

President Hale is arranging for the new headquarters when the firm moves to Los Angeles from Grand Rapids in May of this year.



Father Discharges His Responsibilities

We hear tell that Ed Simpson, the famed Denver geologist, has been foraging about West Texas and Dallas, partly taking care of business and partly shooting the breeze with old friends. Here is an erstwhile Californian who, without the slightest compunction, seems to be able to go beyond the borders of the Golden State and still not only survive but actually thrive. It appears, indeed, that what he needs most to make life a glad song is just to find a few oil men with whom he can exchange a bit of the jargon of the species and it doesn't matter whether he is in Oshkosh or Okotoks, he will have a lovely time.

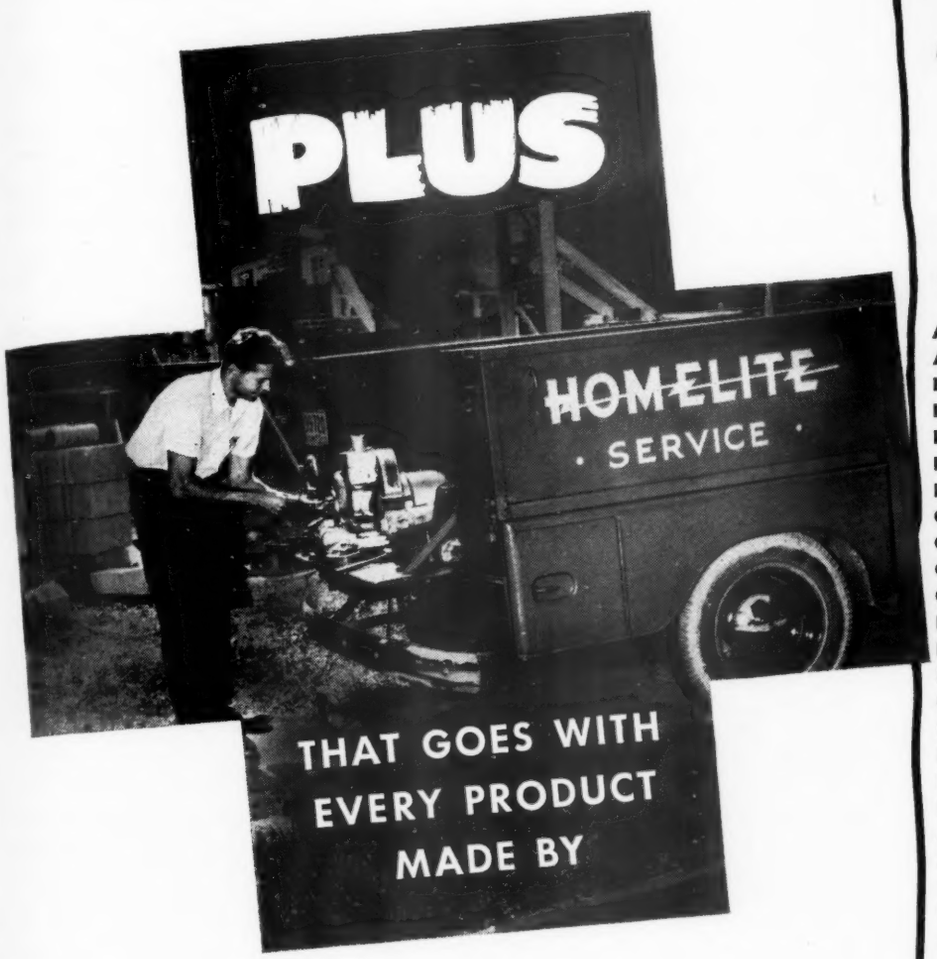
We remember having lunch with Ed, Ken Sclater, and Ralph Marshall about a year ago and the ramifications of our post-dessert converse were deep and devious but highly entertaining. We also remember Ralph telling us later that Simpson Pere was one of the industry's most proficient geologists and after the aforesaid disquisition we found that easy to believe. By the way, we have it on reliable authority that his son graduated from high school not too long ago and like a dutiful father, Ed though the occasion right for one of these heart-to-heart talks that have become an American tradition. They discussed plans and preparations for the future and the conversation was appropriately serious until Ed finally broached the question, "Have you thought about it enough, son, to be really sure what you want to be when you grow up?" "Heck, yes, pop!" replied junior. "What I want to be more than anything else in the world is a rich man's son." Well, looks as if the boy is going to have his wish!

By the Old Moulmein Pagoda

While rampaging around the western petroleic circuit the other day we bumped into one of our favorite people, John Flanagan, the export whiz for Johnston Testers, Inc., entertaining in his customary friendly way, one, David Girsham, from the far-off Burmah Oil Company. We sat in with these lads for a little while and learned some interesting facts about Burma. Dave was born in Yenangyaung, which we would rather write than pronounce, so he knows the Asian republic like the proverbial book.

They have to take care of their own cementations and completions. We asked Dave if he would like to hear us sing the Road to Mandalay but he said, no, he would rather see us take it. Just for a change, at long intervals he manages to get in a game of golf but warns that if one is inclined to hooking or slicing, it is better to stay home from the Burmese courses, because over in the rough one might possibly have to wrestle for the ball with a tiger, a leopard, or something just as unfriendly. Which reminds us that when they cut the rough on the Wilshire Country Club recently, they found Jim MacDonald, the chain belter still looking for the ball he lost last summer.

THERE'S A BIG



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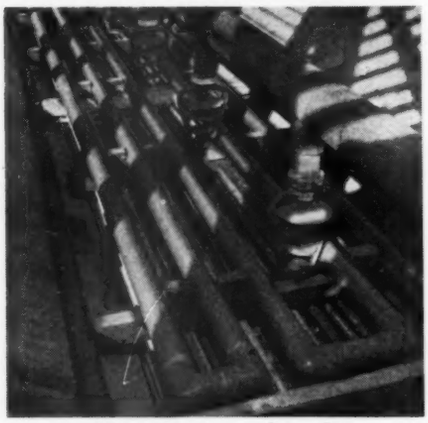

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MEETINGS

March 8-11—**American Institute of Chemical Engineers,** Buena Vista Hotel, Biloxi, Mississippi.

March 9-12—**National Electrical Manufacturers Association,** Edgewater Beach Hotel, Chicago, Illinois.

March 15-19—**American Institute of Mining and Metallurgical Engineers,** Statler Hotel, Los Angeles, California.

March 15-19—**American Chemical Society,** national meeting, Hotels Biltmore and Statler, Los Angeles, California.

March 18-20—**American Petroleum Institute,** Division of Production, Mid-Continent District, Mayo Hotel, Tulsa, Oklahoma.

March 16-20—**Association of Corrosion Engineers,** national meeting, Hotel Sherman, Chicago, Illinois.

March 19-21—**Texas Oil Jobbers Association Inc.,** annual convention, The Plaza Hotel, San Antonio, Texas.

March 23-25—**Western Petroleum Refiners Association,** annual meeting, Plaza Hotel, San Antonio, Texas.

March 23-26—**Institute of Radio Engineers,** national convention, New York, New York.

March 23-27—**American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists and Society of Exploration Geophysicists,** joint annual meeting, Rice and Shamrock Hotels, Houston, Texas.

March 23-27—**American Society for Metals, Western Metal Congress and Exposition,** Pan-Pacific Auditorium, Statler Hotel, Los Angeles, California.

March 28—**North Texas Oil and Gas Association,** annual meeting, Kemp Hotel, Wichita Falls, Texas.

March 30-31—**Texas Independent Producers and Royalty Owners Association,** annual meeting, San Antonio, Texas.

March 30-April 1—**Mid-West Gas Association,** Broadmoor Hotel, Colorado Springs, Colorado.

April 8-10—**American Petroleum Institute,** Division of Production, Eastern District spring meeting, Hotel William Penn, Pittsburgh, Pennsylvania.

April 12-May 23—**Empire Mining and Metallurgical Congress,** Australasian Institute of Mining and Metallurgy, Australia.

April 13-15—**American Society of Lubrication Engineers,** annual meeting and exhibit, Hotel Statler, Boston, Massachusetts.

April 13-15—**Canadian Institute of Mining and Metallurgy,** annual meeting, The McDonald, Edmonton, Alberta, Canada.

April 13-15—**Association of Nebraska Liquefied Petroleum Gas Dealers,** annual meeting, Hotel Fontenelle, Omaha, Nebraska.

April 15-17—**National Petroleum Association,** semi-annual meeting, Hotel Cleveland, Cleveland, Ohio.

April 20-22—**American Petroleum Institute,** Division of Transportation, products pipe line conference, Hotel Muehlebach, Kansas City, Missouri.

April 21—**Association of Consulting Chemists and Chemical Engineers, Inc.,** Hotel Belmont Plaza, New York, New York.

April 21-23—**Southwestern Gas Measurement Short Course,** University of Oklahoma, Norman, Oklahoma.

April 22-24—**American Institute of Electrical Engineers,** South district No. 4, Louisville, Kentucky.

April 24-25—**Interstate Oil Compact Commission,** spring meeting, Roosevelt Hotel, New Orleans, Louisiana.

April 26-29—**American Institute of Chemical Engineers,** joint meeting with **Chemical Institute of Canada,** Royal York Hotel, Toronto, Canada.

April 27-28—**Independent Petroleum Association of America,** mid-year meeting, Jefferson Hotel, St. Louis, Missouri.

April 29-May 1—**Natural Gasoline Association of America,** annual convention, Rice Hotel, Houston, Texas.

April 30-May 1—**American Gas Association,** transmission and storage conference, Edgewater Beach Hotel, Chicago, Illinois.

May 4-6—**Liquefied Petroleum Gas Association,** annual convention, Conrad Hilton Hotel, Chicago, Illinois.

May 5-6—**Gas Hydrate Control Conference,** annual, Engineering Auditorium, University of Oklahoma, Norman, Oklahoma.

May 7-8—**American Petroleum Institute,** Division of Production, Rocky Mountain district, Gladstone Hotel, Casper, Wyoming.

May 10-12—**Pennsylvania Petroleum Association, Inc.,** Bedford Springs Hotel, Bedford Springs, Pennsylvania.

May 11-13—**Southern Gas Association,** Jung Hotel, New Orleans, Louisiana.

May 11-14—**American Petroleum Institute,** Division of Refining, Hotel Commodore, New York, New York.

May 14-23—**International Petroleum Exposition,** Tulsa, Oklahoma.

May 24-27—**American Gas Association,** production and chemical conference, Hotel New Yorker, New York, New York.

May 27-29—**Short Course in Gas Technology,** annual, Texas College of Arts and Industries, Kingsville, Texas.

May 28-29—**Natural Gas and Petroleum Association of Canada,** London, Ontario, Canada.

May 28-29—**Western Petroleum Refiners Association,** regional meeting, Broadview Hotel, Wichita, Kansas.

June 2-3—**American Petroleum Institute,** Division of Production, Pacific Coast District, Statler Hotel, Los Angeles, California.

June 7-12—**Society of Automotive Engineers,** summer meeting, The Ambassador and Ritz-Carlton, Atlantic City, New Jersey.

June 15-19—**American Petroleum Institute,** Division of Production, mid-year committee conference, Hotel William Penn, Pittsburgh, Pennsylvania.

June 16-19—**American Welding Society,** national spring technical meeting, Shamrock Hotel, Houston, Texas.

June 16-24—**European Congress for Chemical Engineering,** Paris, France.

June 18-19—**Pennsylvania Grade Crude Oil Association,** annual meeting, Hotel William Penn, Pittsburgh, Pennsylvania.

AIChE Expects 800

Outstanding chemical engineers from all parts of the country will present a total of 22 papers at the American Institute of Chemical Engineers' meeting in Biloxi, Mississippi, March 8-11, according to W. T. Nichols, president of the Institute.

As many as 800 engineers specializing in fluid mechanics, separation techniques, and other phases of chemical engineering, are expected to be at Biloxi to hear reports by other chemical engineers on their latest studies. Sections of the AIChE at New Orleans and Baton Rouge are acting as hosts.

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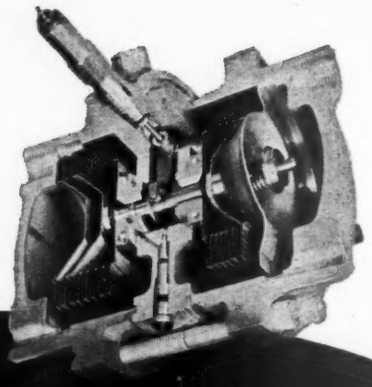

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June 29-July 3—**American Society for Testing Materials,** annual meeting, Chalfonte-Haddon, Atlantic City, New Jersey.

August 31-Sept. 5—**International Association for Hydraulic Research,** arranged jointly with Hydraulics Division of the **American Society of Civil Engineers,** Minneapolis, Minnesota.

Sept. 1-3—**Interstate Oil Compact Commission,** summer meeting, Banff Springs Hotel, Banff, Alberta, Canada.

Sept. 6-11—**American Chemical Society,** national meeting, Conrad Hilton Hotel, Chicago, Illinois.

Sept. 10-11—**Desk and Derrick Clubs of North America,** annual convention, Denver, Colorado.

Sept. 13-16—**American Institute of Chemical Engineers,** Fairmont and Mark Hopkins Hotels, San Francisco, California.

Sept. 16-18—**National Petroleum Association,** annual meeting, The Traymore, Atlantic City, New Jersey.

Sept. 21-25—**Instrument Society of America,** conference and exhibit, Chicago, Illinois.

Sept. 24-25—**Western Petroleum Refiners Association,** regional meeting, Henning Hotel, Casper, Wyoming.

Oct. 6-7—**Texas Mid-Continent Oil and Gas Association,** 34th annual meeting, Rice Hotel, Houston, Texas.

Oct. 7-9—**National Association of Corrosion Engineers,** South Central Region, Mayo Hotel, Tulsa, Oklahoma.

Oct. 8-9—**Illinois Institute of Technology,** Conference on Industrial Hydraulics, annual, Hotel Sheraton, Chicago, Illinois.

Oct. 19-20—**Independent Petroleum Association of America,** annual meeting, Hotel Texas, Fort Worth, Texas.

Oct. 26-29—**American Gas Association,** annual conference, Kiel Auditorium, St. Louis, Missouri.

Nov. 2-4—**Society of Automotive Engineers,** national transportation meeting, Conrad Hilton Hotel, Chicago, Illinois.

Nov. 5-6—**Society of Automotive Engineers,** national fuels and lubricants division, Conrad Hilton Hotel, Chicago, Illinois.

Nov. 9-11—**The Geological Society of America,** annual meeting, Royal York Hotel, Toronto, Canada.

Nov. 9-12—**American Petroleum Institute,** annual meeting, Conrad Hilton Hotel and Palmer House, Chicago, Illinois.

Nov. 30-Dec. 5—**Exposition of Chemical Industries,** Grand Central Palace, New York, New York.

Nov. 30-Dec. 5—**American Society of Mechanical Engineers,** annual meeting, Hotels Statler and McAlpin, New York, New York.

Dec. 13-16—**American Institute of Chemical Engineers,** annual meeting, Hotel Jefferson, St. Louis, Missouri.

NOMADS TO MEET

New York, N. Y., Chapter, First Monday of the Month, Louis Sherry's New York. Secretary, O. B. Latrobe.

Houston Chapter, Second Monday of the Month, Ye Olde College Inn, Houston, Texas. Secretary, Harry E. Estes.

Los Angeles Chapter, Second Wednesday of the Month, Jonathan Club, Los Angeles, Calif. Executive Secretary Wallace A. Sawdon.

Tulsa Chapter, Third Friday, "After Five" Room, Hotel Tulsa. Secretary Gilbert Swift.

Dallas-Fort Worth Chapter, Dallas, Texas. First Monday of the Month. Secretary, M. W. Hiltpold.

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THERMAL METHOD OF LOCATING TUBING LEAKS IN GAS-LIFT WELLS

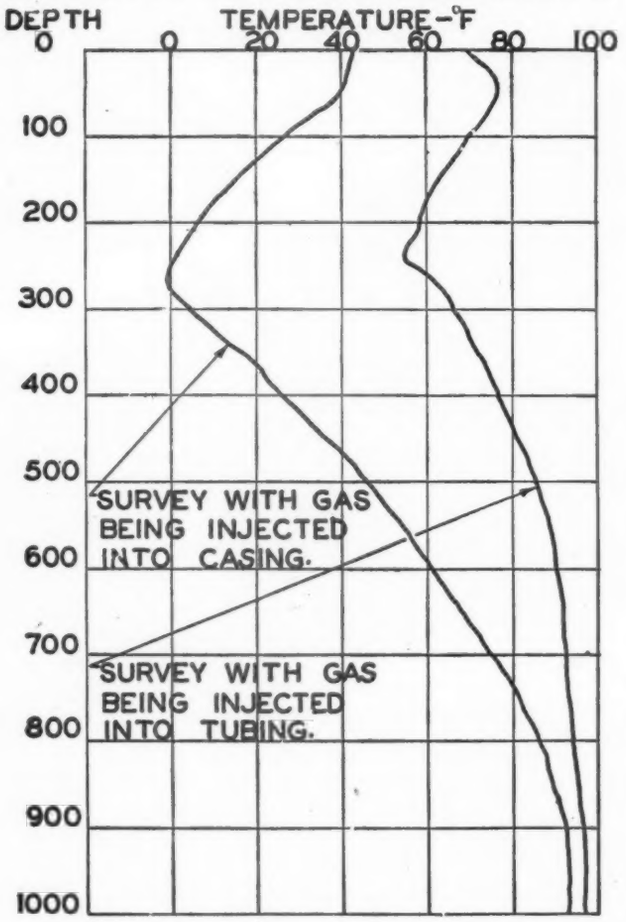
Thermometric measurements often provide a means of obtaining information about conditions taking place outside of one or more strings of pipe. This is illustrated in Fig. 1, where a collar leak in the tubing caused an ice bridge to form more than 200 ft below the surface between the tubing and the casing.

The well had been put on gas lift, and the gas was injected in the casing to lift the fluid through the tubing. The normal injection pressure of 500 psi gradually built up to 1100 psi and the well stopped producing oil although some gas continued to flow up the tubing. A thermometric survey run in the tubing indicated a temperature of 1 deg below 0 F at a depth of 275 ft. A check was made of the pressure between casing strings and it was found to be normal at 250 psi, eliminating the possibility of a casing failure. The injection of gas was reversed from the casing to the tubing and after about 24 hr the well began to produce a small amount of fluid. Two days after the first thermometric survey, a second survey was made with the gas being injected in the tubing, and the lowest temperature recorded was 56 F at 240 ft, indicating that the annulus between the tubing and the casing had been frozen up through a considerable area. In order to thaw out all the area affected, the well was kept on production with the gas being injected in the tubing and the well producing through the casing. After several days the injection pressure dropped gradually as the thawing was completed.

Three hundred feet of tubing was pulled and a bad collar leak was found at 218 ft. The flow of gas through the collar leak apparently started the freezing action and the ice accumulated in the annulus for a considerable distance. The condition in this well was probably very unusual, but there are many conditions affecting the production of flowing wells that are unusual. Many of these conditions might be considered usual if more were known about what was happening in all wells. The instrument on this survey was run at the rate of 6000 ft per hr, and the results show clearly the quick response to the temperature changes and the necessity for continuous recording.

Migration of water behind casing is common in some areas, and thermometric surveys sometimes have indicated water moving from one zone to another 2000 ft higher. Although a condition of this kind may not cause a casing failure for several years, the information about what is taking place can be used to help prevent the same condition occurring in new wells drilled in the same area.

FIG. 1. A temperature survey when gas was being injected into casing shows that an ice bridge formed below 200 ft.



In some fields where multiple completions of several zones were made by the use of various mechanical devices, some of the zones have been produced at a higher rate than others. Due to failure of the mechanical separation of the zones, oil and gas is migrating into the more depleted sands. Large quantities of this migrated oil may never be recovered. Thermometric surveys can be used to detect such migration of oil and gas. Although the instrument is run through the tubing, migration may be detected through several strings of pipe.

Pressure studies frequently are made to obtain information necessary to maintain reservoir pressures, and yet migrating gas and oil can escape from the reservoir to low pressure sands, due to mechanical failures, without being detected by normal operating procedure. One producing well in a field being repressured did not indicate any migration of oil or gas and the condition was not detected on a flowing temperature survey. A shut-in temperature survey was made and it indicated gas was migrating from the producing zone around the casing shoe and into a low pressure sand above. A study of the history of the well disclosed that when the casing was run it froze, and the subsequent cementing job was of doubtful effectiveness. The well had then been cemented through perforations at a higher level. The thermometric surveys made on this well did not indicate how much gas was migrating, but they did disclose that gas was moving into low pressure sands that were supposed to be excluded from the well. The gas, therefore, was not contributing to the building up of the reservoir pressure.

Taken from the article, "Temperature surveys in producing wells," by Clarence R. Dale, published in *The Petroleum Engineer*, September, 1947, pages 146 to 148, inclusive.

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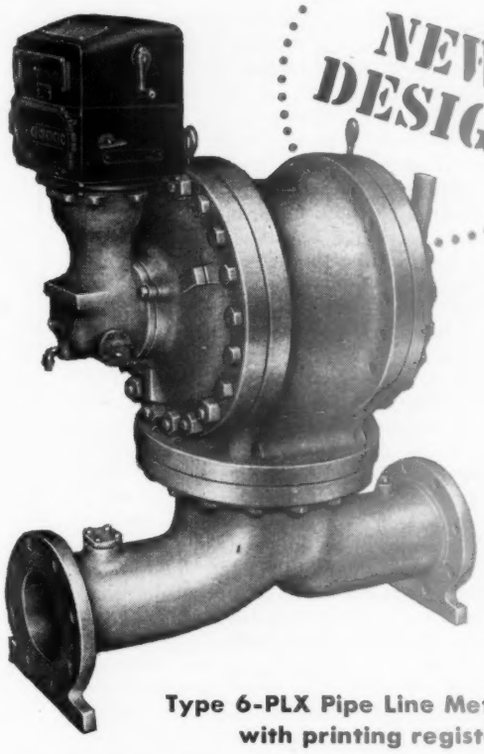

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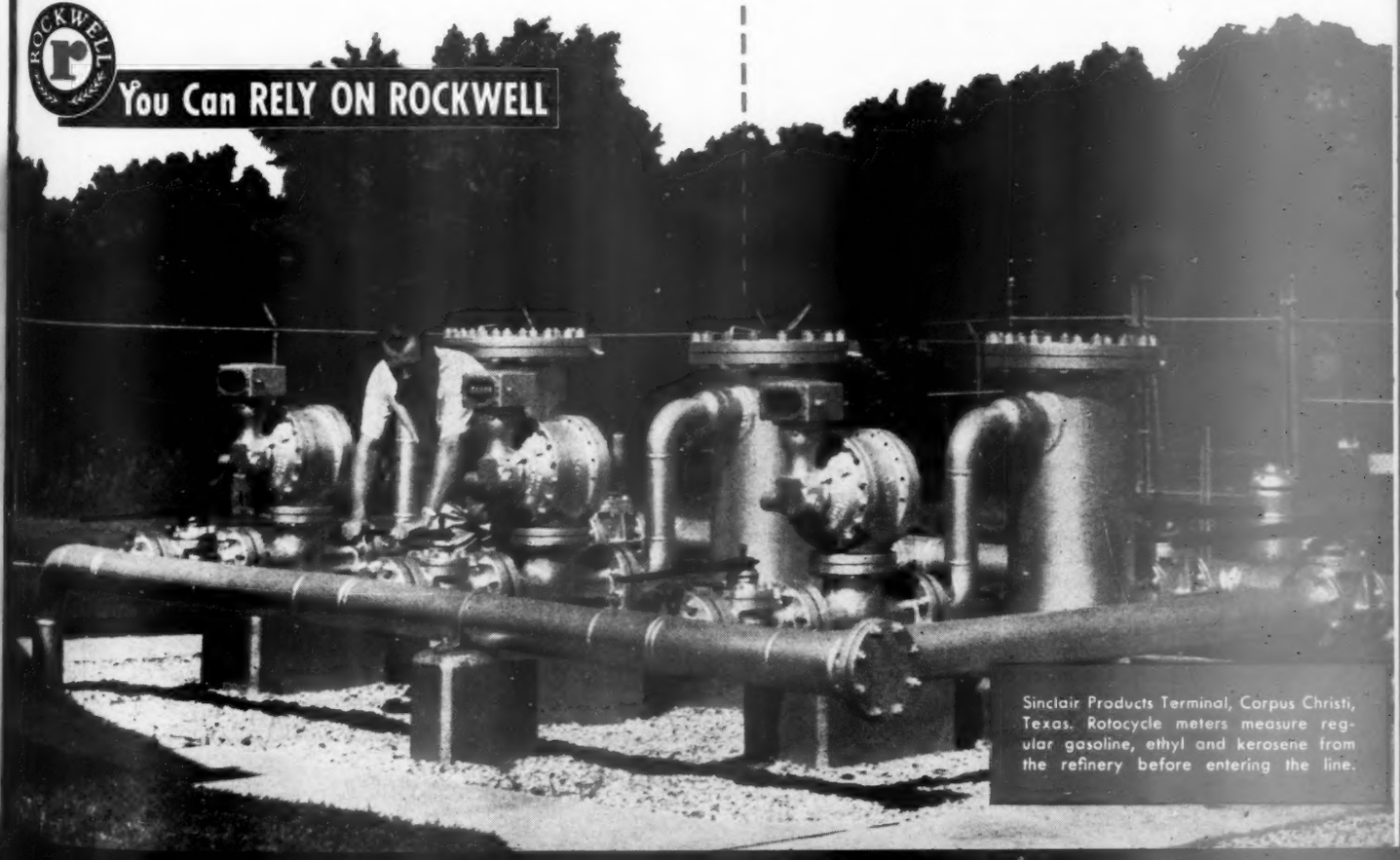


Sinclair Products Terminal, Corpus Christi, Texas. Rotocycle meters measure regular gasoline, ethyl and kerosene from the refinery before entering the line.

THERMAL METHOD OF LOCATING CASING LEAKS IN PRODUCING WELLS

Migrating gas caused serious trouble recently when a drilling well blew out at 1400 ft. It was cemented and the cement was drilled out with heavy mud. Again, all mud was blown out of the hole. Two producing wells near to this drilling well would flow outside of the casing when opened up. Thermometric surveys on these wells, made ith mud, water, and gas flowing outside .he casing, while the tubing was shut in, indicated the fluid and gas were coming from shallow depths that were known to have a lower pressure than the gas that caused the blowout of the drilling well. Surveys were then made on a number of flowing wells in the area around the blowout well to detect upward migration. The surveys were made with the wells shut in. Pressure traverses were also made on some of the wells as the work progressed. One well several hundred feet from the drilling well was found to have an abnormally high fluid level when shut in. It was suspected that this well might be causing the trouble. On a shut-in temperature survey there va no indication of migrating gas. In order to find out whether there was a hole in the casing, gas was injected in the casing, and the pressure leveled off at approximately 1500 psi. A static thermometric survey was run in the tubing. A hole was detected in the casing (Fig. 1). When this well was flowing, gas would migrate out through the hole in the casing and trave' through a fault over to the drilling well with sufficient pressure to blow the mud from the hole. The well was shut in and the migration stopped due to fluid entering the well and balancing the formation pressure.

In Fig. 2, the static geothermal gradient was determined by a survey made after the well had been shut in for several days. The flowing temperature survey was made at a steady rate of flow. The temperature below 6400 ft on the flowing survey follows the static geothermal gradient, because the fluid was static from 6400 ft to the bottom of the well. Above 6400 ft the geothermal and flowing curves separate, the upward movement of fluid producing an almost vertical gradient on the flowing survey. These surveys established 6400 ft as the lowest point from which the well was producing.

Although the bottom of the tubing was above the liner in this well, the .ame results would have been obtained with the bottom of the tubing anywhere in the liner, if the well had been produced through the casing during the survey. Thermometric surveys are made usually after some change has taken place in the well, such as gas entry, migration of fluids, water entry, and other conditions affecting the production.

FIG. 1. A hole in the casing was detected near 2700 ft by a static temperature survey after the well fluid was depressed by injected gas.

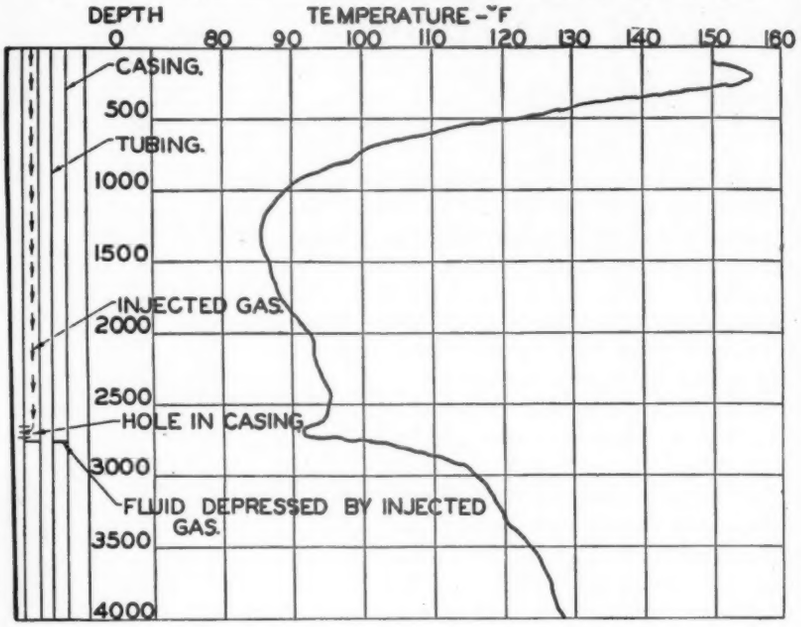
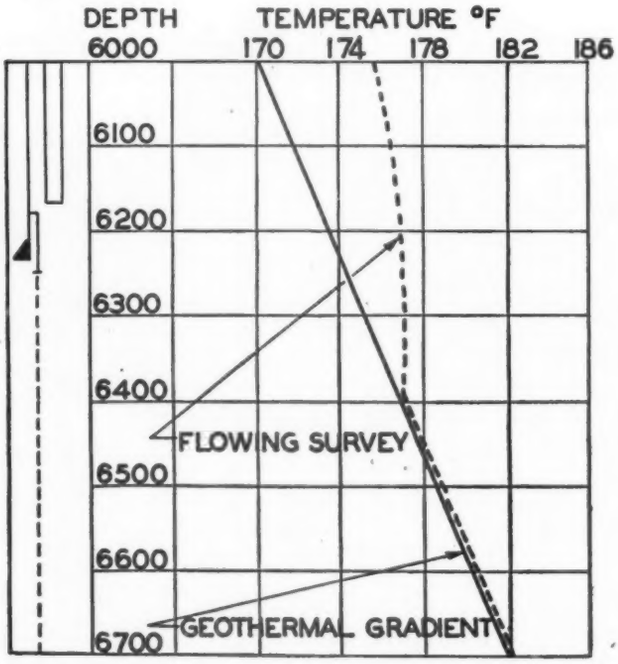


FIG. 2. A static temperature survey (geothermal gradient) of a 6700-ft well shows a regular increase in temperature with depth from 170 F at 6000 ft to 182 F at 6700 ft. The flowing temperature survey shows very little increase from 6000 ft to 6400 ft. This indicates that no production is obtained below 6400 ft when the well is flowing.



Taken from the article, "Temperature surveys in producing wells," by Clarence R. Dale, published in *The Petroleum Engineer*, September, 1947, pages 146 to 148, inclusive.

CONVERSION TABLE FOR MUD WEIGHTS

Specific Gravity	Weight in lb. per gal.	Weight in lb. per cu. ft.	Pressure in lb. per sq. in. per 100 ft of depth	Specific Gravity	Weight in lb. per gal.	Weight in lb per cu. ft.	Pressure in lb. per sq. in. per 100 ft of depth
1.00	8.345	62.50	43.40	1.65	13.76	103.13	71.61
1.01	8.43	63.13	43.83	1.66	13.85	103.75	72.04
1.02	8.51	63.75	44.27	1.67	13.93	104.38	72.48
1.03	8.60	64.38	44.70	1.68	14.02	105.00	79.91
1.04	8.68	65.00	45.14	1.69	14.10	105.63	73.35
1.05	8.76	65.63	45.57	1.70	14.18	106.25	73.78
1.06	8.85	66.25	46.00	1.71	14.26	106.88	74.21
1.07	8.93	66.88	46.44	1.72	14.35	107.50	74.65
1.08	9.01	67.50	46.87	1.73	14.43	108.13	75.08
1 09	9.10	68.13	47.31	1.74	14.51	108.75	75.52
1.10	9.18	68.75	47.74	1.75	14.60	109.38	75.95
1.11	9.26	69.38	48.17	1.76	14.68	110.00	76.38
1.12	9.35	70.00	48.61	1.77	14.76	110.63	76 82
1.13	9.43	70.63	49.04	1.78	14.85	111.25	77.25
1.14	9.51	71.25	49.48	1.79	14.93	111.88	77.69
1.15	9.60	71.88	49.91	1.80	15.02	112.50	78.12
1.16	9.68	72.50	50.34	1.81	15.10	113.13	78.55
1.17	9.76	73.13	50.78	1.82	15.18	113.75	78.99
1.18	9.85	73.75	51.21	1.83	15.26	114.38	79.42
1.19	9.93	74.38	51.65	1.84	15.35	115.00	79.86
1.20	10.01	75.00	52.08	1.85	15.43	115.63	80.29
1.21	10.10	76.63	52.51	1.86	15.52	116.25	80.72
1.22	10.18	76.25	52.95	1.87	15 60	116.88	81.16
1.23	10.26	76.88	53.38	1.88	15.68	117.50	81.59
1.24	10.35	77.50	53.82	1.89	15.76	118.13	82.03
1.25	10.43	78.13	54.25	1.90	15.85	118.75	82.46
1.26	10.51	78.75	54.68	1.91	15.94	119.38	82.89
1.27	10.60	79.38	55.12	1.92	16.02	120.00	83.33
1.28	10.68	80.00	55.55	1.93	16.12	120.63	83.76
1.29	10.76	80.63	55.99	1.94	16.19	121.25	84.20
1.30	10.85	81.25	56.42	1.95	16.27	121.88	84.63
1.31	10.93	81.88	56.85	1.96	16.36	122.50	85.06
1.32	11.02	82.50	57.29	1.97	16.44	123.13	85.50
1.33	11.10	83.13	57.72	1.98	16.52	123.75	85.93
1.34	11.18	83.75	58.16	1.99	16.60	124.38	86.37
1.35	11.26	84.38	58.59	2.00	16.69	125.00	86.80
1.36	11.35	85.00	59.02	2.01	16.77	125.63	87.23
1.37	11.43	85.63	59.46	2.02	16.86	126.25	87.67
1.38	11.51	86.25	59.89	2.03	16.94	126.88	88.10
1.39	11.60	86.88	60.33	2.04	17.02	127.50	88.54
1.40	11.68	87.50	60.76	2.05	17.11	128.13	88.97
1.41	11.76	88.13	61.19	2.06	17.19	128.75	89.40
1.42	11.85	88.75	61.63	2.07	17.27	129.38	89.84
1.43	11.93	89.38	62.06	2.08	17.36	130.00	90.27
1.44	12.02	90.00	62.50	2.09	17.44	130.63	90.71
1.45	12.10	90.63	62.93	2.10	17.52	131.25	91.14
1.46	12.18	91.25	63.36	2.11	17.61	131.88	91.57
1.47	12.26	91.88	63.80	2.12	17.69	132.50	92.01
1.48	12.35	92.50	64.23	2.13	17.77	133.13	92.44
1.49	12.43	93.13	64.67	2.14	17.86	133.75	92.88
1.50	12.51	93.75	65.10	2.15	17.94	134.38	93.31
1.51	12.60	94.38	65.53	2.16	18.03	135.00	93.74
1.52	12.68	95.00	65.97	2.17	18.11	135.63	94 18
1.53	12.76	95.63	66.40	2.18	18.19	136.25	94.61
1.54	12.85	96.25	66.84	2.19	18.28	136.88	95.05
1.55	12.93	96.88	67.27	2.20	18.36	137.50	95.48
1.56	13.02	97.50	67.70	2.21	18.44	138.13	95.91
1.57	13.10	98.13	68.14	2.22	18.53	138.75	96.35
1.58	13.18	98.75	68.57	2.23	18.61	139.38	96.78
1.59	13.26	99.38	69.01	2.24	18.69	140.00	97.22
1.60	13.35	100.00	69.44	2.25	18.78	140.63	97.65
1.61	13.43	100.63	69.87	2.26	18.86	141.25	98.08
1.62	13.51	101.25	70.31	2.27	18.94	141.88	98.52
1.63	13.60	101.89	70.74	2.28	19.03	142.50	98.95
1.64	13.68	102.50	71.18	2.29	19.11	143.13	99.39
				2.30	19.19	143.75	99.82

XUM

let's take a CLOSER LOOK at CAUSES OF TUBE FAILURES

Tubes are critical materials. Peak production of petroleum products is vital to the defense program. These are two urgent reasons for giving extraordinary attention *now* to getting optimum failure-free service from tube installations in petro-chemical facilities.

Of major importance in securing best operating results is an understanding of the numerous factors affecting tube life in high pressure, high temperature applications. Innumerable investigations of tube failures in such service over a 25-year period show that they are most frequently caused by circumstances other than actual physical defects in the tubes themselves. By far the most common causes of failures are overheating, excessive pressures, corrosion, and scaling due to tubes being subjected to improper operating conditions.

Enumerated are some of the more prevalent reasons, based on extensive studies, that account for excessive tube temperatures and attendant failures in chemical and petroleum conversion equipment. These are presented in the hope they will aid engineers and operating personnel to get better-than-ever service from their tube installations.

Through Mr. Tubes—your local B&W Tube Representative—is available a wealth of data on the behavior of tubing steels under conditions embraced in modern processing plants. It may pay you as it has so many others to call on this vast source of useful information.

Some Common Causes of Reduced Tube Life and Increased Maintenance

1. Excessive transfer rates in furnace equipment.
2. Coking of tubes — either expected or extraordinary.
3. Failure to clean tubes at regularly scheduled periods.
4. Unexpected radiation from bridge wall or refractory surfaces.
5. Improperly calibrated fuel meters on burner equipment.
6. Increase of product temperature over a safe design limit.
7. Unequal heating around circumference or along tube length.
8. Excessive furnace temperatures.
9. Guessing at tube metal temperatures.
10. Increase of pump pressure of maintain through-put.
11. Abuse during mechanical decoking, or scaling during burningout operations.
12. Improper supports resulting in bending or sagging.
13. Lack of control of furnace atmosphere to retard scaling.
14. Corrosion of ends or body of tube or both.
15. Carburization and exfoliation of carburized layer.
16. Abrasion or erosion due to coke in fluid stream.
17. Leaky header seats.

Bulletin TR-516 entitled "Some Experiences in Service", contains more detailed information on this timely subject, and is available upon request.

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B&W SEAMLESS and WELDED TUBES

TA 1737(P)

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Rust-Oleum resists rain, snow, heat, fumes, sun, salt water, and chemicals. So easy to use by brush, dip, or spray that one man often does the work of *two.*

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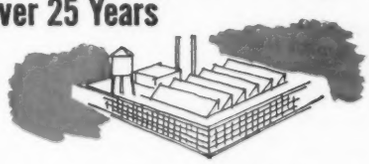

Indoors and out, Rust-Oleum has *proved* its capacity to stop rust! Rust-Oleum can do the same for your tanks, metal sash, stacks, girders, roofs, buildings, machinery, pipes, etc.

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Rust-Oleum is *distinctive* as your fingerprint. It incorporates a specially-processed fish oil vehicle that *dries,* is *odor-free,* and is formulated in *many colors.* Specify Rust-Oleum — accept no substitutes.

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LETTERS

Currency Problem

To The Petroleum Engineer:

The currency situation prevents me from making a subscription to your Journal, although hitherto, I have read it with much interest and profit.

I have retired from Shell service after 26 years and I am now the Senior technical advisor for HMG to the petroleum division of the Ministry of Fuel and Power, 7 Millbank, London, England.

J. B. Kay.

Wants to Reprint

To The Petroleum Engineer:

Permission is herewith requested to reprint "A Message for 1953," as it appears on Page A-4 of the January, 1953, issue of *The Petroleum Engineer*, Refining and Gas Processing Edition.

We believe this message pertains to all phases of the industry, including the members of labor organizations in the industry. Hence, the above request.

In the event that you do not know and are interested to know who we are, the Central States Petroleum Union is an independent organization representing employees of the Standard Oil Company (Indiana). Our paper is a monthly publication, going out to approximately 14,000 members throughout the Indiana Standard territory. *E. H. Hartwig.*

Editor, *Central States Petroleum News*
Wood River, Illinois

Editor's Note: Permission was given to reprint the January editorial on condition that credit was given to the Big Chief Drilling Company and The Petroleum Engineer.

Seeks More Information

To The Petroleum Engineer:

In the January, 1953, issue of *The Petroleum Engineer*, there appears on page A-60 an article entitled "The Origin of Petroleum" by F. Morton.

I have read this article and find it most interesting as well as informative. On page A-70 reference is made to reports by Russell regarding the relationship of the organic content and radioactivity in certain types of organic matter with the comment that "The most satisfactory approach to the problem would appear to lie in the work of Zobell."

Could you please advise where the reports of Russell and Zobell could be obtained in order to study the matter more thoroughly. *I. J. McCullough.*

President
McCullough Tool Company

Supply Is Limited

To The Petroleum Engineer:

On September 16, 1952, we sent you a photograph and description of our new Universal pH recorder/controller.

Publication of this announcement has led to a great deal of interest in the United States, but we would be very much obliged if you would point out to your readers that owing to our heavy commitments elsewhere with this instrument we are not proposing to market the recorder/controller in North America.

The announcement was sent to you originally because of its interest value to your readers, and also because we know that you have a large circulation outside the North American Continent.

W. G. Askew.

George Kent Limited
Luton, Bedfordshire, England.

Lewis Series

To the Editor:

Thank you very much for the complete set of articles written by O. L. Lewis for *The Petroleum Engineer* on gasoline plant design. They appear to be well done, and I am interested in buying 25 or 30 copies after the magazine has reprinted them in one book. Do you happen to know whether the reprint will be offered for sale to the general public? *H. E. Dyer.*

Mechanical Design, Inc.
Tulsa, Oklahoma

Editor's note: This series, "Design of Gasoline Plants, Etc.," will be reprinted and made available eventually.

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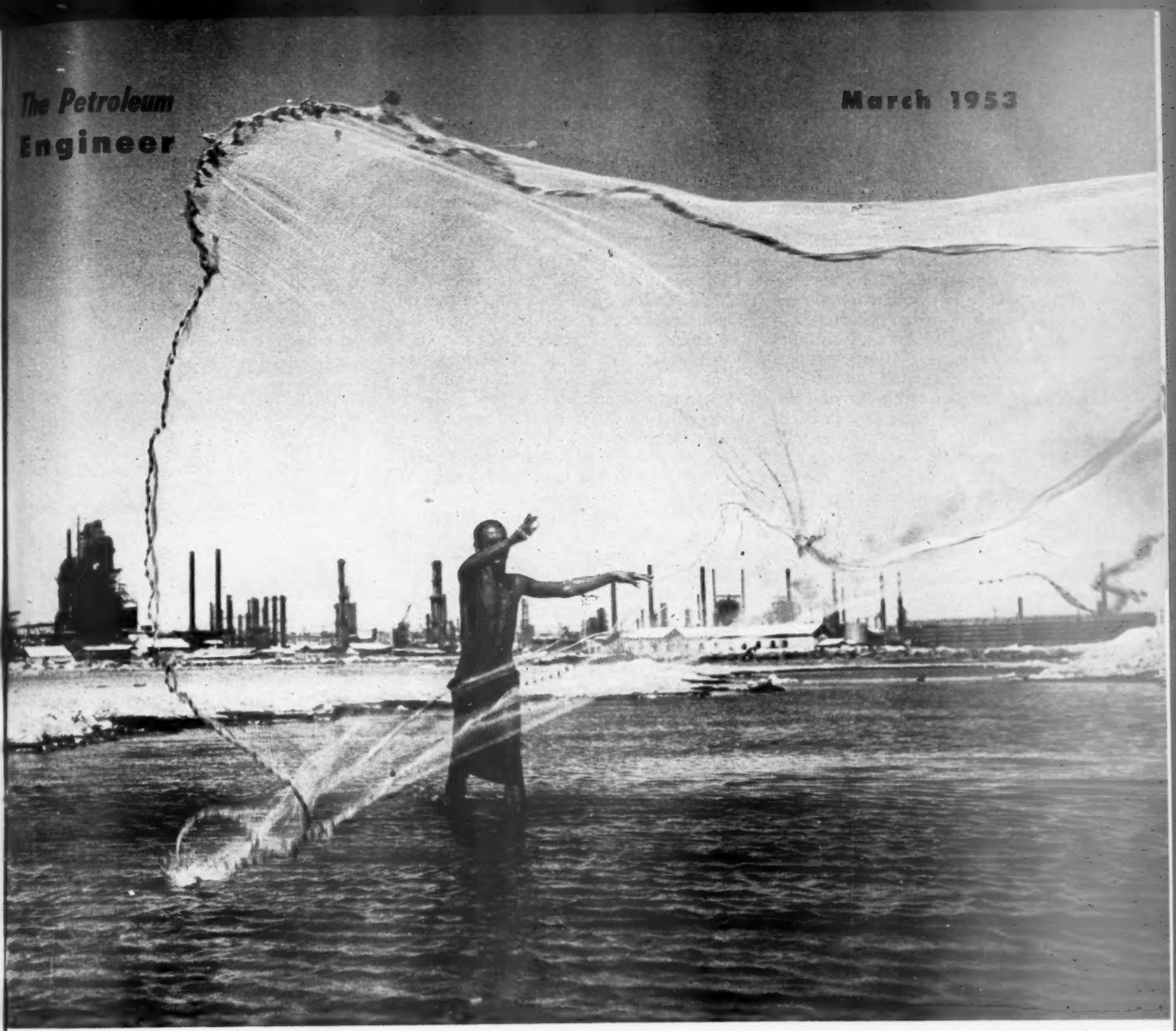


Bahreini fisherman tosses his net near the Bahrein refinery, Persian Gulf. —*Courtesy Caltex.*

P 100.

ROUND-UP OF WORLD OIL ACTIVITIES†

Glimpses of a new "era of promise" came in 1952 when petroleum laws were liberalized in several countries and Turkey invited private industry in for the first time

ERNESTINE ADAMS*

THE year 1952 parted the curtain on a new "era of promise' for the world petroleum industry.

Despite some obvious problems the attitude toward the industry was more favorable in the free world at the close of the year than it had been since Mexico expropriated oil properties of foreign companies within its boundaries in 1938.

In this brighter scene are many countries revising laws and regulations to attract foreign investment in developing oil resources (among them Mexico).

Turkey, after 30 years of looking for oil itself, has invited outside companies to come in and develop its resources. This is something new added by a modern and advanced country — the denationalization of oil properties. It is a symbol of the new era. Egypt is taking another look at its restrictive laws.

New liberalized oil regulations brought dozens of applications for concessions in Peru. Although Colombia

EXCLUSIVE

†Based on reports from governments and companies in foreign lands. There are too many to name individually but I fully appreciate their help in making this survey possible.—E. A.

*Managing Editor.

suffered an unsettling political situation, improved petroleum laws brought good progress in oil and gas development in 1952 and promise of more.

Outside the Soviet sphere of influence there were few spots in the non-communist world where a privately owned oil company could not go if it had any idea it could find oil.

This new atmosphere is not an accident. Confidence has been strengthened in recent years by growing evidence of the industry's capacity for responsibility and acknowledgment by the more progressive governments that industry is better equipped to search for and develop oil resources than any political administration.

There is greater recognition of the stewardship that falls upon companies developing natural resources. The 50-50 division of profits, which is becoming usual, is acknowledgment of this stewardship. In some cases it has been forced upon concession holders but usually they were prepared to accept the conditions.

Also in recent years the granting of an oil concession has been an invitation to aid in raising a country's standard of living. Sometimes these aspirations of the country are included in the agreement; in other cases they are part of the project, anyway. Oil companies develop roads, hospitals, and housing as essentials to the job. They train the native people, establish schools and hospitals, develop sanitation, provide employment, conduct research on health and agriculture, and open the road to economic progress in other fields. These projects are not carried on for charitable purposes. They are an adjunct of efficient oil operations.

Advantages of outside investment in oil and other natural resources development are being eyed with favor in many parts of the world. It is no secret that the responsibility for making Venezuela one of the richest and most progressive of the American republics rests primarily on the heavy investment and successful projects of foreign oil companies. It is no secret that Canada owes much of her sound financial position and growing economic importance to the 125 to 150 private oil companies, which were attracted by fair petroleum laws to develop Western Canada's oil resources.

Other countries are beginning to appreciate the advantages of sharing in oil production without risking huge sums on oil search and development.

As contrast, in Mexico the government company, Pemex, is allotted its entire income, none going to the government as profit or as taxes. Yet these properties were developed when Pemex took over and sums devoted to exploration since have been insufficient. In Brazil one proposal to finance a government-controlled oil company was to tax cars at exceptionally high rates ($100 per year for a Ford).

There were shadows on the 1952 scene. Iran's fanatical nationalism continued to bottle up production and freeze the Abadan refinery operation. The world oil industry had begun to think this shut-down was better than settlement would be, which could mean Iran oil flooding already saturated free markets.

A U. S. politically inspired investigation of the "International Petroleum Cartel" made cumbersome reading and seemed to be even harder on the outgoing Administration than on the oil companies involved. Two of the companies named, which were not in the U. S., Royal Dutch Shell and Anglo-Iranian, ignored the anti-trust action with the approval of their governments.

A warning to U. S. investors abroad was the resolution in a U. N. committee allowing nationalization of foreign holdings without compensation by any nation. Only the U. S. voted against this irresponsible move. Realistically, a country that took such action, like Iran, might find itself worse off than before. Also, it is to be hoped that our U. N. representatives will be more forceful in our cause in the future than they have in the past.

A high mark for daring in 1952 was the proposal of a 2500-mile gas pipe line from Iraq to Europe and England. Bechtel International drew up plans, which were sent to the Mutual Security Agency in Washington to Petroleum Committee, OEEC, in Paris. The plan catches the imagination whether or not it is good economics.

There have been reports that refining capacity has expanded in the last year much faster than consumption and that some countries have a substantial portion of idle capacity. This fact shows up in the detailed survey that follows. But the industry's growth has been too rapid to advance evenly on all fronts and overall world refining capacity is only comfortably ahead of consumption.

Production in 1952, including Russia, averaged about 12,300,000 bbl a day. This is lower than most estimates, principally because of the USSR estimate.

The 850,000 bbl a day estimate made here for the USSR is about 25,000 bbl a day higher than the goal set in 1950, which called for approximately 5 per cent increase each year from the 282,000,000 bbl produced in 1950 to a 450,000,000-bbl goal to be attained in 1960.

A prediction of 935,000 bbl a day by Georgi M. Malenkov can be viewed skeptically. Reports such as the decrease in Baku output and repeated complaints of lagging contradict this optimistic estimate. The 850,000 bbl a day indicates good progress.

Another event of 1952 deserves comment. As far back as 1880, men began drilling near the oil seeps on the coastlands of the beautiful islands of New Zealand. Perhaps 40 tests have gone down in the years since. One went as deep as 10,925 ft. Some oil was found off North Island on the west side where two small fields produced 6 bbl a day for several years. This was the highest point of production until 1952 when Egmont Oil Wells Ltd. made a discovery at about 2000 ft at New Plymouth, close to the other fields. Some 50 bbl of oil are produced each day and gas production is enough to market locally. Sometimes a little petroleum is hard to come by.

Congratulations, New Zealand!

ADEN

Anglo-Iranian Oil Company plans to begin work next year on its new oil refinery on Little Aden, 10 miles west of Aden on the Red Sea. It will be constructed by Middle East Bechtel and George Wimpey and Company and will take about 2 years to complete. The new refinery will supply Anglo-Iranian's large marine bunkering trade at Aden, plus other markets in the Red Sea and Western Indian Ocean areas. The refinery and tank farms will occupy 270 acres of the peninsula. Major plant facilities will have an initial capacity of 100,000 bbl a day.

AFGHANISTAN

Oil exploration in Afghanistan has been protested by the USSR. This was one of the Afghan projects undertaken by the government with U. S. assistance. Whether this included the French company organized for Afghanistan exploration is not clear. This company planned to drill the first well in the country.

ALASKA

Naval Petroleum Reserve No. 4, comprising an area of about 37,000 square miles, was created by Executive Order of President Harding in February 1923. There is an additional area of about 39,000 square miles withdrawn from the public domain by Public Land Order No. 82 in January, 1943, which is available to the Navy for exploration. Thus, the Navy's present oil exploration program in North Alaska involves evaluation of the entire sedimentary basin in Alaska north of the Brooks Range. Captain R. H. Meade, U. S. Navy, is director of the Naval Petroleum Reserves.

Exploratory activities during 1952 consisted of the completion of 6 test wells, 3 seismic crews working a total of 15 crew-months, 3 surface geological parties, photogeological mapping of selected anticlines, and other surface and subsurface geological studies.

Of the 6 test wells, one was oil productive and 2 were gas productive.

No oil was produced except during testing operations. Total gas production during 1952 consisted of 140,000,000 cu ft from South Barrow gas field to supply the Barrow camp.

Exploration in North Alaska in 1953 will be conducted in the foothills belt with emphasis on the pre-Cretaceous horizons. Two test wells are planned, one in the southwestern part of the Reserve and one in the area east of the Reserve. Both wells will test prospective horizons through the Lisburne limestone (Mississippian). Field work will be accomplished by three surface geological parties and one seismic crew.

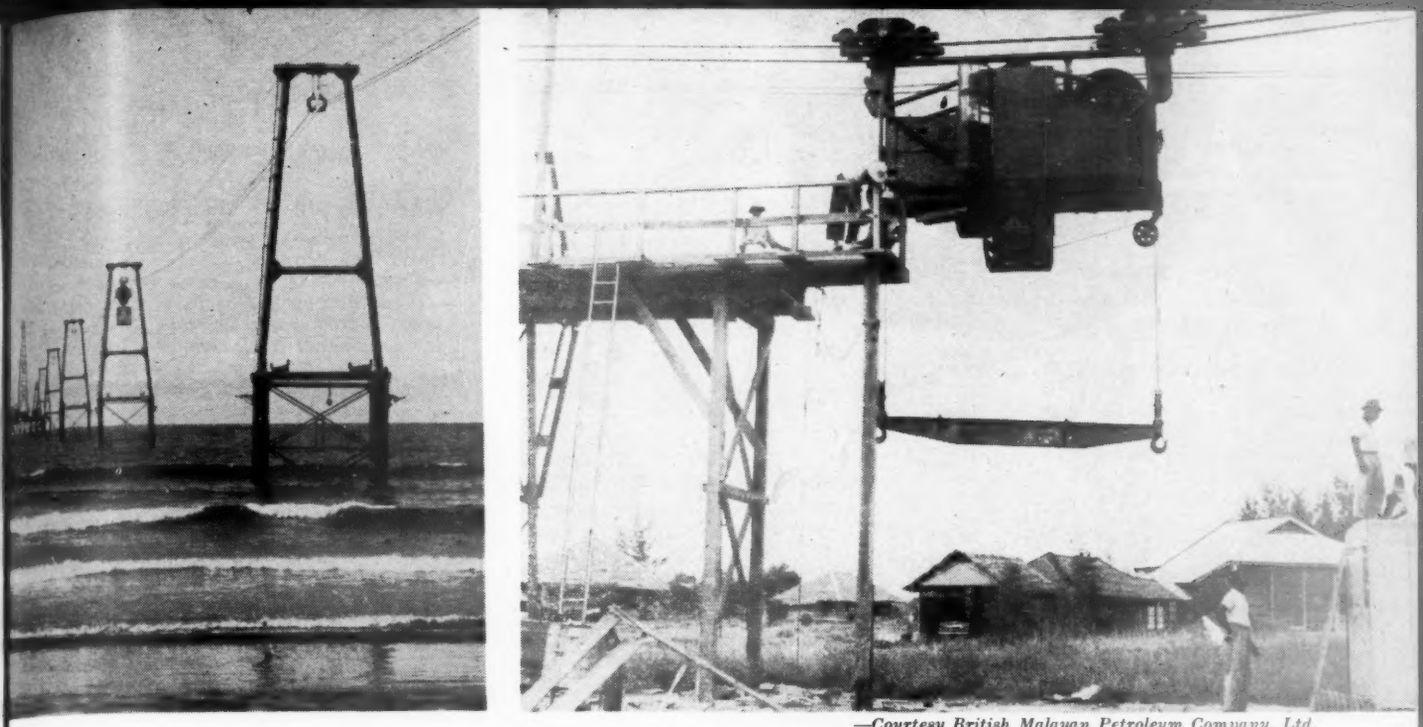
Geological field studies were also conducted in Alaska by Union Oil Company of California and Ohio Oil Company in a joint operation. They had two field parties.

Early in 1953 Phillips Petroleum signed an agreement with Secretary of Interior McKay to explore a million acres in the Katalla-Yakataga area, on the Gulf of Alaska, to drill 12 tests within 10 years, to spend a minimum of $1,200,000 before June 30, 1956, and a sum equal to 40 cents an acre annually thereafter. This is almost as spectacular a move as the decision of Turkey.

ALBANIA

Prod. 5000 b/d **Ref. Cap. 3500 b/d**

The refinery capacity estimate includes the new plant reported at Tserrick, southwest Tirana, which was scheduled to be completed with the assistance of Russian materials. The production figure is the same as estimated last year. It is doubtful if the small fields in Albania can do more than maintain production rates.



—Courtesy British Malayan Petroleum Company, Ltd.

Civil engineering highlight of 1952 was the erection and coming into service of a mile-long aerial ropeway connecting Seria oil field in British Borneo with a marine drilling platform on the bed of the South China Sea. At right is a transporter car to carry men and material out to the marine drilling location. Seria field had 210 wells producing oil before offshore drilling was attempted.

ALGERIA

Prod. 950 b/d

La Société Nationale de Recherche et d' Exp.oitation des Petroles en Algerie (S. N. REPAL) did its major research in the regions of the Chelif Basin, the northern edge of the High Shelf, in the region of Constantine and the Sahara. The geophysical exploration used six crews for gravimeter seismography magnetism. Seven rigs at the disposal of S. N. REPAL drilled 96,128 ft.

The only producing area has been the Oued Gueterini, near the Sidi-Aissa, on the northern edge of the High Shelf. Thirty-two wells were drilled in that area with two light rigs. Production for 1952 was 346,000 bbl with output rising at the end of the year.

Exploration permits for hydrocarbons were granted for the Sahara to REPAL and to Compagnie Francaise des Petroles. Shell has also acquired a concession in Algeria, a country with no objection to foreign investment in oil properties.

Algiers was host to the 19th International Geological Congress in 1952.

ANGOLA

This west coast of Africa territory is being explored by Portuguese authorities in Ambirzet where asphalt has been found. Jersey Standard completed about 10 months of geological survey work along the coast in 1951. A Belgian company has a new concession.

ARGENTINA

Prod. 70,000 b/d Ref. Cap. 170,000 b/d

In this country where only the YPF government oil monopoly can expand, private companies are gradually coming to the close of operations. Jersey Standard and Shell oil fields are evidently drilled up, as production is off. Texas Company and Socony-Vacuum have already withdrawn from Argentina, selling their holdings to the Peron government.

Argentina made an agreement with the National Iranian Oil Company to supply some of the imports, which reach 66,000 bbl a day, but since neither had the tankers to haul the oil the deal fell through. In a later agreement between Britain and Argentina Anglo-Iranian and Shell were to supply oil imports amounting to 80,000 bbl a day.

AUSTRALIA

Ref. Cap. 21,000 b/d

Seismic work was carried on in western Australia by West Australian Petroleum Pty., Ltd., owned jointly by Ampol and Caltex.

Outstanding news of Australia's petroleum situation is the vast expansion of refining capacity scheduled for construction. Three companies, Shell, Caltex, and Anglo-Iranian will have new refineries. The largest of these will be the Anglo-Iranian plant at Kwinana. It will have a capacity of 100,000 bbl a day and will cost $89,600,000.

Total new refining capacity will be 127,500 bbl a day at an estimated cost of $200,000,000. The Shell plant will have 25,000 bbl daily and will cost $25,000,000. Vacuum's refinery at Altona, Vic., will be expanded to 22,000 bbl a day by 1956.

A 58-mile products pipe line will link the new Shell refinery at Geelong to Newport.

AUSTRIA

Prod. 40,000 b/d Ref. Cap. 29,000 b/d

Shell and Socony-Vacuum have carried on some seismic surveys in the Molasse and Graz basins. A British concern has been granted exploration concessions.

There is little news about producing oil fields, which are Russian-controlled.

There is no news of expansion of refinery operations in the Russian-controlled zone.

BAHAMA

A new company, the Bahama-California Oil Company, Ltd. (Standard of California) was granted a license by the Petroleum Board covering 15,000 square miles of the Bahamas, stretching from the West Grand Bahama bank to northern Andros and embracing several islands south and southeast of New Providence. The new venture is being undertaken after studies of the findings of previous surveys in this area, which include sections formerly leased to other companies. Extensive operations are expected to begin in April.

Bahamas Exploration Company (Gulf) continued its gravimeter work, then switched to seismic work in its search for a drilling location.

Bahamas Oil Company (Superior) has cancelled all its licenses.

BAHREIN

Prod. 30,000 b/d Ref. Cap. 155,000 b/d

Six new wells were drilled in Bahrein in 1952 to maintain the production it has had for several years.

Crude runs averaged 192,000 bbl a day, well over the capacity, because facilities were used to their best advantage to make up for the closing of the Abadan refinery in Iran. A 26,000 bbl a day expansion is now under construction.

Spelling was changed from Bahrain to Bahrein January 1, 1953.

Under a new decree by the ruler on December 6, 1952, a 50-50 income tax is levied on companies engaged in the production of crude petroleum in Bahrein.

Caltex holds the only concession.

BARBADOS

Barbados Gulf Oil Company, Ltd., holds a prospecting license over a total area approximately 100 square miles within and bordering on the island of Barbados. Geophysical work leading up to the selection of a drilling location was completed in 1952 and the company rigged up for a deep test to be called Gulf Turner Hall No. 1.

BELGIAN CONGO

Geophysical exploration was carried on near Bonde during 1952. Bitumen is being mined and experiments in processing it are underway.

A products line from Ango Ango to Leopoldville is under construction by Petro-Congo. It is a 6-in. 225-mile line.

BELGIUM

Ref. Cap. 82,000 b/d

The Albatros refinery in Antwerp is being expanded and modernized. It will be

enlarged from 3500 to 11,000 bbl a day capacity. The new Esso Standard plant at Antwerp with 25,000 bbl a day capacity is completed. Several others are planned. Societe Industrielle Belge des Petroles has a number of additions planned for its Antwerp refinery.

BOLIVIA

Prod. 1500 b/d Ref. Cap. 10,500 b/d

YPFB, the government oil monopoly, manages to produce slightly more oil than the country consumes. The refining capacity so far is not needed and crude runs to stills is about the same as the country's production.

Although the government has revised the petroleum law in an effort to gain foreign capital, the move does not seem successful. Exploration and development drilling does no more than maintain past production.

BORNEO (British)

Prod. 105,000 b/d Ref. Cap. 43,500 b/d

High production comes from Seria field in Brunei and about 1200 bbl a day from Miri field on Sarawak. Seria is the largest field in the British Commonwealth.† British Malayan Petroleum drilled 24 wells in Seria in 1952 and now has 210 wells producing. One rig is drilling offshore.

Drilling rigs capable of drilling 10,000 ft are being used in exploration in Sarawak.

Sarawak Oilfields refinery at Lutong runs at full capacity of 43,500 bbl a day or more.

In North Borneo Shell has completed a seismic survey of the Klias Peninsula and reports that it is promising.

BORNEO (Indonesia)

Prod. 14,500 b/d Ref. Cap. 46,000 b/d

Although the entire project is not completed, the Balik Papan refinery construction is nearing a full capacity.

Production has been maintained by development of wells and some exploration was carried on by the Shell organization.

BRAZIL

Prod. 2200 b/d Ref. Cap. 10,000 b/d

The largest country in South America spends almost all its dollar balance on imported oil. This will be cut some in 1953 when several new refineries can begin processing imported crude. One is a 25,000 bbl a day capacity refinery at Capuava 20 miles from Sao Paulo. A pipe line will be built to bring crude oil from the seacoast port of Santos 50 miles way. This is a privately owned enterprise. Hydrocarbon Research Inc., is a contractor for it and also for the National Petroleum Council's 45,000-bbl refinery at Cubatao.

The 2500-bbl a day plant at Mataripe is being expanded by M. W. Kellogg Company. Rio Grande refinery is being expanded from 1000 to 5000 bbl a day capacity.

Other refineries are in the planning stage.

The National Petroleum Council's activities in exploration and production have been a constant drain on Brazil's treasury and consequently is the cause of considerable dissention politically. Opinion goes from the extreme nationalist to the anti-administration element, which would like to see the country opened up to foreign enterprise under government regulation.

BULGARIA

This country behind the Iron Curtain, has been the subject of many rumors but virtually no news. Last report was about discovery of Bulgaria's first oil field near the Romanian border where exploration has been reported for several years.

†*The Petroleum Engineer*, August 1952, Page B-86.

BURMA

Prod. 2000 b/d Ref. Cap. 2000 b/d

Production is due to the operating companies persistence in maintaining its field at Chauk.

Oil operations are carried on under the great handicap of guerrilla warfare.

Burma Oil Company is expanding its refinery at Rangoon by about 50 per cent.

CAMEROUN

SEREPCA has a research permit for this French Mandate territory on Africa's west coast. Seismic work and core drilling were carried on in 1952.

CANADA

Prod. 180,170 b/d Ref. Cap. 550,000 b/d

Canadian oil operations experienced in 1952 another year of record breaking achievements. Canada is fast becoming the third largest oil producing country in the Western Hemisphere, and may displace Mexico this year. Rapid strides were made to put Canada on a basis of self sufficiency "on balance."

Production was increased by 37,000 bbl per day to make a daily average of 180,170 bbl. Some 6,500,000 ft were drilled, which was an increase of 16 per cent, or 1,040,000 ft, over 1951. Number of rotary rigs for operations was 275.

Alberta was again the area of concentrated operations. Canadian Williston Basin in Saskatchewan had some wildcat discoveries and this region may develop into an important oil area. The bi-provincial Peace River district of British Columbia and Alberta loomed up as a great gas potential region. Future drilling will probably become feverish.

Geophysical activity was at an all time high with 185 crews in the field.

Expenditures in land purchases, exploration, and general operations reached the record figure of $250,000,000. The oil reserves were increased and stand around the 2 billion barrel mark. Proved natural gas reserves are approximately 7 trillion cubic feet, a conservative estimate to say the least.

Increased interest was shown in the Athabasca tar sands in the past year. This 200 billion barrels reserve may be produced commercially in the foreseeable future.

The Trans Northern Pipe Line Company completed its 440-mile 10-in. products line, which extends from Montreal to Hamilton with a branch to Ottawa. Trans Mountain Pipe Line Company completed about half its line between Edmonton and Vancouver. This will be a 24-in. line 711 miles long. Other line completions were Imperial's 188-mile line from Toronto to Sarnia and Interprovincial's 16-in. oil line from Regina to Superior, Wisconsin.

Advances in refining in Canada reflect both the need for more crude processing and for improved products. Beginning 1952 with about 450,000 bbl per day crude refining capacity, at least 110,000 bbl of crude capacity was added or placed under construction during the year. Catalytic cracking to the extent of about 75,000 bbl per day was added during the year and the most important of the product capacities expanded. With the more than 100,000 bbl per day of catalytic capacities at the beginning of 1952 the total now is not far from the 200,000 bbl per day mark. At least 4 new refineries were either building or newly completed by January 1, 1953.

CANARY ISLANDS

Ref. Cap. 140,000 b/d

Compania Espanola de Petroelos, S. A. is constructing a 5000 bbl per day Platforming unit at its refinery at Santa Cruz, Tenerife, in the Canary Islands. Plans are for Kuwait crude oil to be used. The Universal Oil products unit is being built by Procon, Inc.

CHILE‡

Prod. 2500 b/d Ref. Cap. 7500 b/d

The state-owned company Empresa Nacional Del Petroleo drilled 7 exploratory wells in 1952, one of which produced oil and gas. In 5 fields 23 wells were drilled of which 11 produced oil, 3 gas, and 9 were dry.

A gasoline plant was completed in Magallames. In addition a refinery is under construction at Concon which will have a capacity of 20,000 bbl a day. It is designed by M. W. Kellogg Company.

Operations in Chile are carried on entirely by the government. Favorable oil territory is apparently limited to the extreme southern end of the country.

CHINA (Communist)

Prod. 2000 b/d Ref. Cap. 2000 b/d

Present production of Red China is estimated by the Bureau of Mines at about 2000 bbl a day. Refining capacity may be considerably higher than that estimated above, but there has been no news of new plants and certainly the old ones must be in disrepair.

Bureau of Mines' estimate of throughput is 2000 bbl a day. The last direct report in 1947 before the Communists took over gave China some 10,000 to 15,000 refining capacity. It is uncertain how plants fared in the civil war.

COLOMBIA

Prod. 106,000 b/d Ref. Cap. 33,000 b/d

Despite an unstable political situation, oil operations in Colombia have progressed surprisingly well since the government made its petroleum laws more liberal in 1950. In December 1952, oil legislation was amended and regulations are being drafted. A large number have applied for concessions.

The government has granted exemption from import duties to heavy drilling equipment in an effort to liberalize laws that have obstructed oil operations.

Production at Texpet's Velasquez field rose from 465,827 bbl in 1951 to 1,360,153 bbl in 1952. The company has built a 42-mile 4-in. and 6-in. line from Velasquez to Intercol's topping plant at La Dorado, which has a 4000 bbl daily capacity but had runs of only 2100 bbl in 1952. Texpet also has acquired a new concession in the vicinity of Cucuta.

One of the reasons for the favorable attitude in recent months was the successful negotiations between the government and International Petroleum Corporation, a Jersey Standard affiliate, when the latter relinquished its 30-year concession, which included the DeMares field. Intercol signed an agreement with the government-owned company to provide technical advice and to lend the government $10,000,000 for expansion of the refinery at Barranca. Intercol continues to operate the state-owned concern and has acquired new concessions.

Exploration is being carried on by International, Richmond Petroleum Company of Colombia (Standard of California), Shell and Colombian Petroleum Company (Socony-Vacuum and Texas Company).

Intercol carried out geological and/or geophysical operations in middle and upper Magdalena Valley and the Caribbean Coastal platform. Some drilling was done in the Totumal region, middle Magdalena Valley. Out of three wells, one found oil.

Richmond has acquired two new concessions during the year and carried on geological and seismic activities in the Atrato Valley. The deep test on the Goajira Peninsula

‡See Page A-181.

on the west coast was abandoned as a dry hole. The company plans to continue exploration this year.

Colombian continues to operate Barco concession and has been granted a new concession, Mercedes No. 36, west of Barco. The company is constructing a gasoline absorption plant of 60,000,000 cu ft capacity, which should be operating by the end of this year. It is also constructing a 220 bbl a day refinery in Tibu to replace the 900 bbl a day plant at Petrolea.

COSTA RICA

Union Oil of California continued in 1952 doing surface geology and aerial mapping of its Costa Rica concession. A new petroleum code has been set up in the island and Union Oil expects to pursue its exploration work and possibly do some geophysical work in 1953.

CUBA

Prod. 40 b/d **Ref. Cap. 7300 b/d**

Atlantic Refining is maintaining its concessions in Cuba on an inactive basis. Cuban Gulf Oil Company exploratory tests off the north coast of the mainland was abandoned February 8, 1952, at a total depth of 11,218 ft. Geological field and laboratory work continued throughout the entire year.

CZECHOSLOVAKIA

Prod. 750 b/d **Ref. Cap. 2500 b/d**

Here is another Russian-dominated country. It is reasonable to believe that both production and refining operations are under a severe handicap with the known political unrest in this country. There are few places more vulnerable to sabotage than refineries.

DENMARK

Ref. Cap. 700 b/d

The Danish American Prospecting Company's deep test Tonder No. 1 in South Jutland was temporarily abandoned at 10,248 ft in June 1952. Another deep test Tonder No. 2 was drilling at 10,155 ft at the end of the year. Seismic work continued throughout the year. Four stratigraphic tests were completed as follows: Rodby No. 1 at 5035 ft; Arnum No. 1 at 6060 ft; Frederikshavn City No. 2 at 3542 ft; Frederikshavn City No. 3 at 3307 ft. At the end of the year stratigraphic test Aabenraa No. 1 was drilling at 3065 ft.

ECUADOR

Prod. 8000 b/d **Ref. Cap. 5700 b/d**

Anglo-Eduadorian Oilfields, Ltd., completed a well in the Santo Tomas area in September that flowed over 1000 bbl a day and to the end of October produced 40,000 bbl in 48 days. This was one of 62 wells completed by the company as producers in the area. The normal initial production is 50 to 70 bbl a day.

Manabi Exploration Company discovered a gas field five miles southeast of Santo Tomas field at its No. 1 Filomena. The company has just completed a gas absorption plant in the area.

Anglo-Ecuadorian and Manabi Exploration are the only companies operating at present in Ecuador.

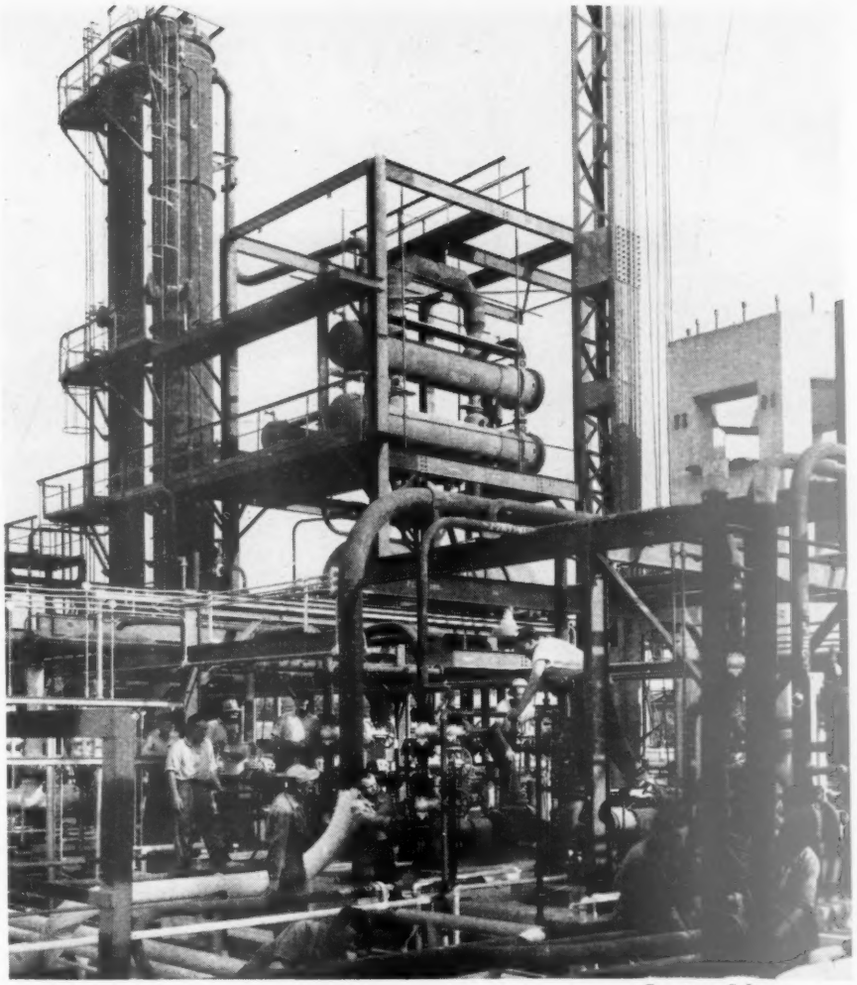
Crude runs to stills are below capacity but gasoline plants are improved and producing higher volume.

Empresa de Ferrocarriles Ecuatorianos is constructing a 6-in. products line from Guayaquil to Palmira, some 50 miles.

EGYPT

Prod. 44,500 b/d **Ref. Cap. 47,000 b/d**

The new ruler, General Naguib, is apparently too busy organizing his political set-up to give time to the petroleum situation. Restrictions of Egyptian laws have forced most companies to limit operations to present production or to withdraw from the country. Observers feel that the new regime will approach the petroleum laws more objectively since agreement over the Sudan with Britain.



—*Courtesy Caltex.*

Italian construction workers building a crude unit at the Sarpom refinery at Trecate. Some 20 miles west of Milan, the installation will serve the rich Po Valley, the products to be marketed by Petrolcaltex.

ETHIOPIA

Exploration of this African nation is pursued by Sinclair, which holds a concession over the entire country. A second well is being drilled near Galadi.

FORMOSA

Prod. 60 b/d **Ref. Cap. 18,000 b/d**

Almost no production on this island and refining capacity is not fully used. Crude runs, however, have almost doubled since last year, running about half of capacity.

FRANCE

Prod. 7000 b/d **Ref. Cap. 455,000 b/d**

The year was one of expansion for France, both in crude production and in refining capacity.

An intensive exploration program is being carried out by French companies backed by the government with some 40 rigs active; in addition, some outside firms, particularly Jersey Standard and Atlantic Refining are interested in exploratory plans.

Although no new fields were discovered, development progressed in known fields in southwestern France.

Crude runs have not reached capacity in recent months. Shell completed its Pauillac refinery expansion, raising capacity from 6300 to 12,000 bbl a day.

The U. S. government plans to build a 12-in. 375-mile products pipe line from the French coast to U. S. European air bases. This may be revised under the new administration at Washington.

FRENCH EQUATORIAL AFRICA

Societe de Petroles d' Afrique Equatoriale Francaise carries on most of the survey work and test drilling in this West African territory although Jersey Standard has done some geological work in the area. Three drilling rigs have been active.

GERMANY (West)

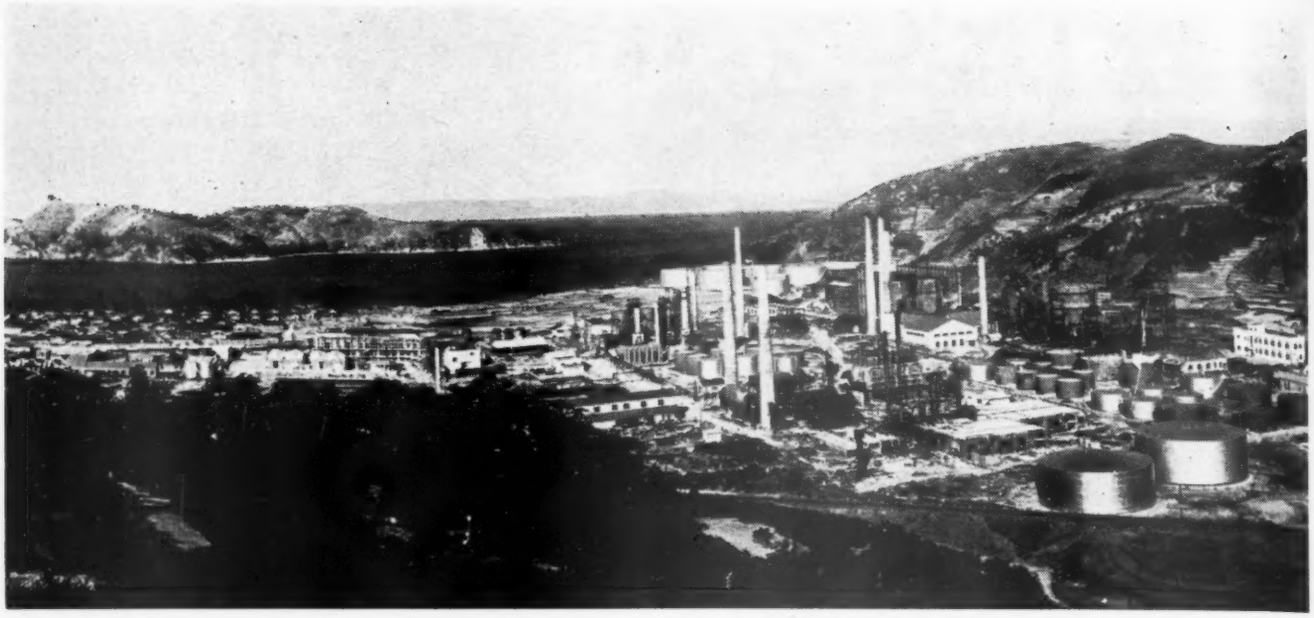
Prod. 32,000 b/d **Ref. Cap. 150,000 b/d**

Western Germany production has increased with more efficient development of its fields and the discovery of two more fields in 1952.

Expansion was still more pronounced in refining. Anglo-Iranian raised capacity of the Julius Schindler refinery from 2500 to 4200 bbl a day and renovated Eurotank refinery, which has a 14,700 bbl a day capacity.

Socony-Vacuum built the first TCC unit in Europe at Nienburg.

Other plants are planned or being constructed. There is competitive enterprise in West Germany. Besides the German firms



Wakayama refinery in Japan shows progress under long-term rehabilitation and expansion program being carried out by Standard-Vacuum's refining affiliate, Toa Nenryo Kogyo K.K. Plant is charging 12,000-bbl, chiefly fuel for products production. It has a 3500-bbl thermal cracker, and recently began production of high-grade lubricants. Deep-sea tanker facilities, behind hill at right, are reached by pipe line through the hill. Total refining capacity in Japan is now 124,000 bbl a day and is still expanding.

Anglo-Iranian, Socony, Shell, Jersey Standard have interests in the West German oil industry.

HONDURAS (British)

Bahamas Exploration Company (Gulf) carried on some seismic operations here.

HUNGARY

Prod. 900 b/d Ref. Cap. 23,000 b/d

These are the same figures we have estimated for three years for this USSR satellite. The oil industry is completely nationalized and only reports have been those of grumbling by the Soviet masters that the "quota" has not been met.

INDIA

Prod. 6000 b/d Ref. Cap. 6100 b/d

Digoi, a field operated by Assam Oil Company, a subsidiary of Burmah Oil, is the only oil-producing area in India. Several unsuccessful wildcats were drilled in 1952.

During 1952 Standard-Vacuum Oil Company completed an airborne magnetometer survey of parts of the Bengal Basin area in eastern India and East Pakistan. Stanvac also is conducting preliminary ground surveys in Tripura, eastern India.

After reaching an agreement with the government of India late in 1951, Standard-Vacuum Oil Company in 1952 acquired a site for a 25,000 barrel-per-day refinery on Trombay Island in Bombay Harbor. Preliminary construction operations by The Lummus Company, contractors for the $35,000,000 project, are underway. Burma Shell also plans a refinery near Bombay.

IRAQ

Prod. 370,000 b/d Ref. Cap. 12,000 b/d

In April 1952 the 555-mile 30/32-in. pipe line of Iraq Petroleum, from Kirkuk to Banias was completed. This enabled the 1952 production of oil from Kirkuk to be doubled as compared with 1951. The total for 1952 was 115,000,000 bbl. Two rigs were employed at Kirkuk and one field well was drilled. Three exploration wells and one field well were in progress at end of year.

Agreement providing for the equal sharing of the profits between the Iraq Government and the Iraq Petroleum group of companies was ratified by both houses of the Iraq Parliament in February 1952. It was effective from January, 1951.

At Ain Zalah, two rigs were employed during the year by Mosul Petroleum Company, Ltd., one field well was completed and one exploration well was in progress at the end of the year.

A 12-in. 134-mile pipe line from Ain Za'ah to K.2 Pump Station was completed. This pipe line joins the main pipe line system from Kirkuk to the Mediterranean at K.2. In the last three months of 1952 some 1,900,000 bbl of oil were exported.

The Zubair field of the Basrah Petroleum began to export crude by the end of December 1951, and by 1952 about 17 million barrels were exported from the terminal at Gao. A 75-mile 24-in. pipe line will soon be completed from Zubair field to Fao.

Five rigs were employed and during the year nine field wells were completed. One exploration and six development wells were in progress at the end of the year.

IRAN

Prod. 30,000 b/d Ref. Cap. 550,000 b/d

Limited production has been possible, something like 30,000 bbl a day, it is said, for local use but nothing like the 700,000 bbl a day production before nationalization.

The Abadan refinery, with its more than 500,000 bbl a day capacity is still closed down except for a small crude run for domestic use.

The question of Iran's oil is wrapped in so many problems that it will be difficult to solve it without solving all other problems. Attempts on the political level have been prolonged almost two years by Prime Minister Mossadegh's refusal to compensate the British-owned Anglo-Iranian Oil Company for expropriating oil-producing properties and refineries.

In the blockade by the British to prevent sales of Iranian oil one Italian-chartered ship, Rose Mary, was held at Aden where the British court ordered the oil cargo turned over to AIOC. An appeal is pending. Another Italian ship is said to have run the blockade successfully.

ISRAEL

Ref. Cap. 85,000 b/d

The Israel Petroleum Law 5712-1952 provides for three stages in the granting of oil rights:

1. Preliminary permits, granted to carry out geological and geophysical work only; 2. licenses, for exploration work and test drilling, and 3, leases after the discovery of oil.

Four preliminary permits have been issued and several applications for licenses are being considered. Two holders of preliminary permits are held by local together with foreign capital. The foreign capital is represented by American, Belgian, and Swiss companies. The other two preliminary permits are held by Canadian oil companies. The first licenses were to be granted in February 1953.

Geological and geophysical work has been carried out in 1952.

Crude runs were 6,400,000 bbl during 1952 or an average of 17,500 bbl a day.

Disagreement over the operation of the pipe line from Kirkuk holds down throughput.

Construction was completed on a chemicals and fertilizers plant in Haifa to produce 520 bbl per day of ammonia from paraffinic hydrocarbon gas. Present plans call for the plant to be put on stream in 1954.

The Knesset (Parliament) passed Israel Petroleum Law 5712-1952 on August 31, 1952, and regulations to that law were to be promulgated by the end of January 1953.

Test drilling in Israel should be started late this year after all necessary licenses have been granted. Holders of preliminary permits have begun preparations to drill.

ITALY

Prod. 1600 b/d Ref. Cap. 250,000 b/d

State oil monopoly is increasing production to some degree aided by loans from the International Bank.

Refining capacity, an industry open to foreign capital, has more than doubled in the last year and has temporarily outpaced demand as crude runs are about 20 per cent below capacity. Plans are to export motor fuel in 1953.

Caltex-Fiat is building a 13,500 bbl refinery at San Martino di Trecate and Condor is building a 30,000 bbl plant at Rho. Shell enlarged its La Spezia from 17,000 to 30,000 bbl a day capacity. Other refineries are being improved and expanded.

Azienda Generale Italiana Petroli is constructing gas lines from Cortemaggiore to Genoa (110 miles), Cortemaggiore to Bologna (90 miles), Ripalta to Bergamo (40 miles), and Cremona to Ghera (120 miles).

JAPAN‡

Prod. 5850 b/d Ref. Cap. 124,000 b/d

One discovery in the Shinjo Basin of Yamagata helped oil exploration. Initial production was 100 bbl a day, which is high for Japanese wells.

Improved conservation practice brought production for the country down slightly. Water flooding was introduced in Yabase field.

Refining capacity is expanded and plans for additional capacity have been made by Caltex and some Japanese oil men.

Cooperation between Japanese and U. S. oil companies has been a large factor in furthering oil operations in this country.

JAVA (Indonesia)

Prod. 13,000 b/d Ref. Cap. 5600 b/d

Rehabilitation of fields and refineries have accomplished about all that is possible. Production is up, almost reaching pre-war output and the two plants are in better shape to handle part of it.

KENYA

Prospects for petroleum were given a good rating in the British African territory of Kanya bordering the Indian Ocean. A geological survey was made by U. S. geologists, financed by ECA, and Kenya Geological Survey has prepared a report on an air survey.

The local government has invited applications for oil and gas concessions.

Shell will undertake an extensive survey along the coast and is considering building a refinery near Mombasa. Anglo-Iranian and Socony-Vacuum geologists are making an examination of northeast Kenya.

KUWAIT

Prod. 750,000 b/d Ref. Cap. 30,000 b/d

The Kuwait Oil Company (Anglo-Iranian and Gulf) completed its Makwa No. 1 wildcat situated 8 miles north of Burgan field and followed this discovery with a step-out drilling program resulting in seven successful extension wells. A second successful wildcat was completed on the Ahmadi Ridge structure to the east of Burgan and Magwa at the close of 1952. In addition, 12 inside development wells were completed in Burgan field, bringing the total wells drilled to date to 131. Exploratory geophysical work continues.

KUWAIT NEUTRAL ZONE

American Independent Oil Company and Pacific Western Oil Corporation, both U. S. independent groups, continued their exploratory activities in the Kuwait-Saudi Arabia neutral zone throughout the year. A comprehensive seismograph reconnaissance survey was completed. One test well was drilled in the southeastern section of the Neutral Zone and was abandoned after having produced no interesting shows. At the close of the year the companies were engaged in a joint program of structure drilling in areas of possible interest. They are drilling their sixth test to 9000 ft. Others have been dry.

‡See Page A-55.

LEBANON

Ref. Cap. 11,000 b/d

Bureau of Mines figures show Iraq Petroleum refinery at Tripoli running at full capacity.

LIBYA

This central north African country became an independent nation January 1, 1952. It has attracted oil investigations for years and most of the drilling tests in the Tripoli vicinity have had shows of oil and/or gas. More examination of possibilities in the republic depends upon laws and regulations agreed upon.

MADAGASCAR

Standard-Vacuum is conducting a preliminary geological survey of potential oil-bearing areas along the West Coast of the island of Madagascar in the Indian Ocean off Africa.

MEXICO

Prod. 220,000 b/d Ref. Cap. 235,000 b/d

A discovery of importance in 1952 was Ezequiel Ordonez field. Second well drilled was reported to have a potential of 25,000 bbl a day. The field is within 20 miles of Mexico's greatest producing area, Poza Rica, on the Gulf Coast.

Another discovery was made by Mexican American Independent Company (CIMA) at Rabon Grand.

The new discoveries need facilities for development and, meantime, old fields are declining despite secondary recovery programs. The great weakness of Pemex appears to be lack of a strong exploration program.

Pemex, state oil company, had a budget of $231,000,000 in 1952 and pursued development of the country's oil resources and distribution system. The budget represented the amount of income estimated for the year. One project is a new lube plant, the nation's first, being built at Salamanca, by Arthur G. McKee and Company. Two long crude oil lines and three gas lines are already under construction with others planned.

MOROCCO

Prod. 2200 b/d Ref. Cap. 2200 b/d

Societe Cherifienne des Petroles (French and Morocco governments) are meeting some success in its oil search in the Northwest African French Protectorate. Two fields were added in the last year and a substantial drilling program was carried out. Financing by ECA has spurred exploration and drilling activities. The Petitjean refinery handles the crude.

MOZAMBIQUE

The Mozambique Gulf Oil Company continued geophysical work on its Mozambique concession and on October 25, 1952, spudded a wildcat well Domo No. 1, which was drilling ahead at 6789 ft at the end of the year.

NETHERLANDS

Prod. 13,500 b/d Ref. Cap. 128,000 b/d

The Shell-Jersey Standard field is the only oil field in Holland although exploratory drilling has found several gas fields. Distribution lines are being built to utilize the gas production.

The two refineries at Pernis are running crude at 145,000 bbl a day. Shell's plant, the largest in Europe, has a capacity of 100,000 bbl a day and plans are to add another 67,000 bbl a day capacity in 1953. Caltex refinery capacity is 18,000 bbl a day.

NETHERLANDS WEST INDIES

Ref. Cap. 685,000 b/d

Aruba's Lago refinery (Jersey Standard), which is the largest in the world since Abadan shut down, is running more crude than its 430,000 bbl a day capacity. The Shell refinery here has 35,000 bbl.

On Curacao the Shell refinery has 200,000 bbl a day capacity.

Crude runs average about 790,000 bbl a day for the three refineries.

NEW GUINEA

Prod. 4600 b/d

Shell, Standard-Vacuum, and Caltex hold the concession operated by Shell. Klamono field is the only one producing.

Exploration in southeastern New Guinea has been expensive and unsuccessful.

NEW ZEALAND

Prod. 50 b/d

New Plymouth Island off New Zealand is presently producing about 50 bbl high gravity oil a day. Operators are New Zealand Oil Refineries, Ltd., and Egmont Oil Wells, Ltd. Oil seepages were observed over a century ago on the mainland. New equipment is being brought in and the search for oil will be stepped up.

NIGERIA

A deep test northeast of Owerri in this British West African colony had shows of gas about 8600 ft. A Shell-Anglo Iranian company has conducted a search by geological methods and this is the first actual drilling test.

NORWAY

Ref. Cap. 1000 b/d

No change in the operations of the Vall plant except crude runs are higher than capacity, about 1100 bbl a day.

NOVA SCOTIA

Geologists drilling salt and limestone deposits near Anaigonish found natural gas early in 1952 for the first time in Nova Scotia. Officials said the gas was discovered about 400 ft down.

PAKISTAN*

Prod. 4500 b/d Ref. Cap. 5000 b/d

Pakistan Petroleum, Ltd., a Burma Oil affiliate, has carried on an intensive exploratory program including drilling. The company in late 1952 found a field at Chak Naurank near Chakwal in the Punjab, the discovery well flowing 200 bbl initially. Gas was found in another wildcat of the company at Sui and another well is being drilled here as well as two major tests in East Pakistan.

Local companies and Standard Vacuum are carrying on a vigorous exploration program.

BOC has offered to construct a new refinery at Karachi of about 10,000 bbl a day capacity for the Pakistan government.

PAPUA

Australasian Petroleum, which has been exploring Papua, has a deep test in the south. The territory comprises the east half of the island of New Guinea and is a part of the Australian Commonwealth. Active exploration has been carried on since the last world war by British, Dutch, and U. S. companies. Millions of dollars have been spent without a commercial discovery.

In 1952 Australian Petroleum abandoned Hohoro No. 2 at 10,642 ft as a dry hole. Island Exploration was drilling Omati No. 1 at 11,839 ft in December.

* See *The Petroleum Engineer*, July 1952, page A-40.

Concessions in Peru, and companies that hold or have applied for them.

Companies	Concessions applied for		Concessions abandoned	Concessions held		Overlapping applications	
	Exploration Acres	Development Acres	Acres	Exploration Acres	Development Acres	Exploration Acres	Development Acres
Coastal zone							
Compania Peruana de Petroleo "El Oriento" S. A.	290,590	.....	24,707	48,431	.....	217,448	.....
Compania Sudamericana de Petroleo S.A.	.....	131,968	.....	.....	38,421	.....	93,547
Consorcio Minero del Peru	24,710	.....	.....	24,710	.....	.....	.....
Conorada Petroleum Corporation	867,073	121,079	349,646	43,242	83,025	474,182	38,053
International Petroleum Company Ltd.	932,536	247,107	272,721	235,330	144,795	424,480	102,299
Peruvian Gulf Oil Company	1,059,671	.....	548,057	137,429	.....	374,181	.....
Peruvian Oil Concessions	.....	106,621	.....	.....	44,864	.....	61,772
Peruvian Oil and Minerals Ltd.	121,424	19,308	54,579	44,183	17,751	24,215	.....
Petrolera Peruana S.A.	983,875	.....	158,148	595,572	.....	230,151	.....
Petrolera San Miguel S.A.	25,745	.....	.....	25,745	.....	.....	.....
Richmond Oil Company	741,300	247,100	99,455	290,777	206,313	351,064	40,783
Seacil Limited	735,332	247,097	194,069	113,455	149,883	427,806	97,214
A. y F. Wiese	332,015	.....	48,431	249,015	.....	34,594	.....
	6,114,281	1,120,282	1,749,826	1,807,902	685,045	2,558,129	433 677
Eastern zone							
Compania Peruana de Petroleo "El Oriente" S.A.	1,895,356	.....	52,508	1,789,723	.....	54,124	.....
Compania de Petroleo Ganso Azul Ltda.	257,764	.....	.....	254,058	.....	3,706	.....
Peruvian Oils and Minerals Limited	900,264	104,399	65,415	772,518	104,399	61,330	.....
	3,054,384	104,399	118,023	2,816,299	104,399	119,160	.....

Note: The International Petroleum Company Ltd. and the Peruvian Gulf Oil Company, before applying for extensions that are shown above, relinquished 197,227 acres and 106,035 acres respectively.

PERU

Prod. 45,000 b/d Ref. Cap. 37,500 b/d

New Peru petroleum laws have attracted a number of companies into the South American country, which has had oil production since 1896. The Sechura desert in the coastal zone was soon blanketed by applications. (See table.) Overlapping applications by both foreign companies and Peruvian-owned companies finally decided the government to hold auctions for these areas.

International Petroleum (Jersey Standard) carried out geological and geophysical operations on the La Brea-Parinas Estate (including some drilling) and in the Sechura desert region, and surface work in the jungle east of the Andes. The same activities will be continued in 1953.

International produced most of the oil in Peru at its La Brea-Parinas Estate field. Company daily production of this and areas of joint development during 1952 was 32,293 bbl of oil, 2400 bbl of natural gasoline, and 71,400,000 cu ft of gas.

International's Tulara refinery had runs of 36,800 bbl a day. It has contracted for construction of a 45,000 bbl a day crude pipe still to be completed by mid-1954.

PHILIPPINE ISLANDS

No reports of success have been received from the long search for oil in the Philippines. Besides the Philippine Oil Development Company, the national Bureau of Mines has been doing geological survey work.

Big news for the Philippines in 1952 was the announcement of the first refinery for the Republic. Caltex will build a $30,000,000 plant with 13,000 bbl crude capacity.

POLAND

Prod. 3500 b/d Ref. Cap. 15,000 b/d

Reports from behind the Red censorship indicate considerable effort toward developing Polish fields. Plans also were reported for a greatly expanded refining capacity.

PORTUGAL

Ref. Cap. 10,000 b/d

Compania Portugueza do Petroleo has done some exploration work.

Portugal's only refinery at Lisbon is scheduled to go on stream in 1953 with capacity more than doubled.

PUERTO RICO

Cosden Petroleum Corporation, Big Spring, Texas, has been considering constructing a 12,000 bbl refinery near San Juan Bay to process Venezuelan crude. Estimated cost is $6,500,000. Some financial aid may come from the Puerto Rico government.

QATAR

Prod. 67,000 b/d

Superior Oil affiliate relinquished offshore concession from 3 to 12 miles in submerged waters and it was acquired by Shell interests.

The big Dukban field, only producing area, was extended and production was increased during the year. Operator of this field and concession holder of the shekdom is Petroleum Development (Qatar), an affiliate of Iraq Petroleum, which recently negotiated a 50-50 profit agreement with the Shiek of Qatar.

ROMANIA

Prod. 75,000 b/d Ref. Cap. 100,000 b/d

Oil properties confiscated by the Red regime evidently are not doing well, judging by complaints of their operation by officials. Exploration and drilling are continuing and at least one new discovery was reported. Development drilling is heaviest, however, in the effort to maintain production.

The 24 officials of the government oil monopoly in the Ploesti area, who were arrested by the Red Romanian government, pled guilty to sabotage of oil operations. It was charged that output of Ploesti fields fell by about half.

At the same time the oil commissar announced Romania had more than filled its oil quota. The contradiction was not explained.

Refining capacity is a guess. Some old refineries, including much of the Ploeti plant, have closed down and new ones are being constructed but their present status is unknown.

SAKHALIN

Prod. 9000 b/d

This is USSR territory and estimate is a guess only. Oil from here supplies Communist forces in Korea. It is probably processed at Nikolaevsk refinery.

SAUDI ARABIA

Prod. 855,000 b/d Ref. Cap. 200,000 b/d

Saudi Arabia moved into third place as an oil producer in 1952. Only the U. S. and Venezuela produced more in 1952.‡ This output was from four fabulous fields although two discoveries of 1951 were being developed and shut in.

Refinery runs at Ras Tanura were running at 172,511 bbl a day crude oil. The plant expansion underway should be completed in 1953.

‡Some estimates show production in the Soviet Union greater than in Saudi Arabia.

The balance of the production goes by Trans-Arabian pipe line to Sidon, Lebanon, on the Mediterranean, where a thousand or more tankers load it for West Europe's refineries.

SICILY

Ref. Cap. 10,000 b/d

American International Fuel and Petroleum Company (Gulf) initiated a structure drilling program on its Ragusa concession in June, which was continued through the remainder of the year. Geological and geophysical work being carried out in Sicily by this company was continuous throughout the year.

MacMillan Petroleum of California and Gulf are jointly drilling a deep test on land they are exploring.

D'Arcy Exploration Company, Anglo-Iranian subsidiary, is increasing its search for oil in Sicily where it is at work with a gravity meter survey team. The company has about 350 square miles under license in southern and eastern Sicily for three years.

Sicily's petroleum laws are more liberal than those of Italy and attract more foreign-owned companies.

Rasiom's 10,000 bbl a day refinery at Augusta is to be expanded to 20,000 bbl.

SOMALILAND

Conorado Petroleum, a Canadian company owned by Continental Oil, Ohio Oil, and Amerada, has an exploration license over the British East African protectorate. Shell formerly held this concession and gave it up in 1950.

Concession over the section of Somaliland under U. N. and Italian control is held half by the above firms and half by Sinclair, which has the concession over Ethiopia, north of Somaliland.

SOMALIA

AGIP (Italian government oil company) did some geological work in this Italian mandate on the eastern tip of Africa in 1952.

SOUTH AFRICA

In mid-1952 Standard-Vacuum decided to add 175,000 bbl per year of asphalt capacity to the refinery it is building at Durban. The plant, costing about $22,665,000 will process 15,600 bbl a day of fuel products, and is expected to go into operation late in 1953. Foster Wheeler is the contractor.

A 4½-mile pipe line is being built from the refinery site to the deep-water terminal on Durban Harbor. Stanvac affiliates have constructed an underwater section across the harbor's entrance, the first submarine oil line in South Africa.

The Duchess of Kent examines a bottle of crude oil drawn from the well, which she christened in the Seria oil field in Borneo, as a representative for Queen Elizabeth. With her is the Duke of Kent, left, with R. E. Hales, managing director of the oil fields. At right is an Indonesian worker at a Christmas tree of a Caltex Pacific well in the expanding Minas field of Central Sumatra.

SPAIN

Ref. Cap. 32,000 b/d

Several companies hold exploration concessions in Spain and geological work and some drilling were done without any report of success. CIEPSA, largest Spanish oil company, and CAMPSA have rigs going in the country. An American firm composed of several Texas companies is surveying a concession near Lograna and a German firm has joined CIEPSA to explore another section of the country.

The Escombreras refinery of REPESA was being completed at the end of the year by McKee. It will add 8000 bbl capacity. The same company's Cartagena plant has been expanded.

SUMATRA

Prod. 148,000 b/d Ref. Cap. 147,000 b/d

In Central and Southern Sumatra Shell, Standard-Vacuum and Caltex are carrying on production and refining operations, both improving in the past year.

Caltex began shipping oil from its Minas field in Central Sumatra in May. After returning to the field in 1950, Caltex drilled 33 wells, laid a 12-in. pipe line from the field to Perawang terminal on the Siak River, from where it was transported to the ocean terminal at Sungai Kakning in shallow-draft tankers.

Standard of California uses its experience in Sumatra in its advertising (Page E-28) this month. Some $62,000,000 has been spent to make Sumatra oil available.

In North Sumatra Communist labor leaders have held out against return of the properties to their owner, Royal Dutch Shell. Under the local government there was labor strife and operations were about one-fourth pre-war level.

SWEDEN

Ref. Cap. 24,800 b/d

The Swedish method of storing oil in rock cavities has aroused interest in other countries.

Two largest refineries are at Nynashamm and at Goteborg.

SWITZERLAND

Ref. Cap. 2000 b/d

About a dozen companies are interested in exploring for oil in this small republic. D'Arcy Exploration began geological surveys early in 1952. There is a dispute over whether the cantons or the federal government has the right to grant concessions.

Two small refineries in this country have not expanded. Largest is at Rotkreuz.

SYRIA

This Iraq Petroleum concession is still in exploratory status. Tests have been discouraging.

TRIESTE

Ref. Cap. 18,000 b/d

Aquila and Jersey Standard each has a refinery in Trieste, the former much larger with a capacity of about 15,000 bbl a day.

TRINIDAD

Prod. 58,200 b/d Ref. Cap. 110,000 b/d

During the past year Dominion Oil, Ltd., a subsidiary of Standard Oil of California, has entered the Trinidad oil industry. Dominion has been granted a marine license over approximately 383,000 acres in the Gulf of Paria and a mining lease over 40,000 acres of land in the Cocal Ward of Trinidad.

During 1952, 187 new wells were begun and 182 completed. Of these 177 produced oil; 5 were dry holes. Total footage drilled was 736,535 ft, an average of 4286 ft per well.

The 15,000 bbl catalytic cracking plant at Trinidad Leaseholds, Ltd., Pointe-a-Pierre was brought on stream in September 1952 and is operating satisfactorily. Average runs for all refineries in 1952 were 98,000 bbl a day.

TRUCIAL COAST

Deep wildcatting by Petroleum Development (Trucial Coast), Ltd., an affiliate of Iraq Petroleum, has been unsuccessful so far. The first test went to 13,000 ft before being abandoned. Another wildcat was drilled this year to 12,353 ft and a third is drilling.

TUNISIA

Gulf operating in partnership with the French government in a company called SNAP spudded a wildcat well, Ste. Juliette No. 1 on June 21 and this well was drilling ahead at 9506 ft at the end of the year. Geophysical exploration work being carried out in Tunisia by this company continued through the year.

Oil was reported 90 miles southwest of Tunis in the mountain area of Tunisia by CPDT, a company in which Shell and SEREPT are interested. Engineers for the Societe D'Etudes Pour les Recherches Petroliferes said it was too early to say what the discovery amounted to. Oil, mixed with natural gas, is reported to have spurted over the top of a derrick in a mountainside clearing outside the town of Kesra from a depth of 1800 ft.

This French-controlled territory in North Africa has attracted and held considerable interest over the years.

XUM

Production of crude oil in Venezuela. Year 1951 and January, February, March, April, May, June, July, August, September, October, and November, 1952.*

Companies	1951	January	February	March	April	May	June	July	August	September	October	November	Average January to November
Creole.....	773,663	814,073	820,796	810,709	817,961	830,225	813,115	782,552	744,471	780,842	828,645	824,951	806,677
Shell.....	527,321	571,659	564,339	573,342	574,593	569,999	560,585	567,462	535,132	491,004	497,188	550,304	550,503
M. G. O.....	245,273	258,647	269,978	265,745	267,790	271,490	277,527	274,350	269,310	269,671	273,616	276,295	270,375
Socony.....	49,319	52,703	56,680	58,050	57,049	60,232	58,471	59,151	57,808	58,731	59,038	58,725	57,879
Mercedes....	23,177	24,216	25,243	25,159	25,192	25,256	25,440	25,626	24,892	25,059	24,503	24,403	24,997
Richmond...	13,489	15,833	19,820	16,279	19,419	19,992	20,911	23,425	24,339	24,828	20,482	14,982	20,029
Texas.....	23,625	22,495	19,362	18,392	19,546	18,792	19,524	21,149	19,605	19,249	15,460	17,309	19,173
Atlantic.....	18,932	17,936	17,459	17,146	17,403	17,741	18,558	17,071	16,089	16,779	17,625	17,106	17,354
Sinclair.....	12,481	14,063	14,108	13,539	12,210	12,385	11,915	11,723	13,432	13,358	13,230	12,993	12,997
Phillips.....	6,371	10,615	10,952	12,202	9,683	9,370	10,031	9,807	9,674	8,619	8,108	8,208	9,752
Pantepec....	10,042	8,513	8,696	8,428	8,178	7,984	7,654	9,897	9,090	8,543	8,758	8,308	8,553
British.....	949	940	988	958	943	941	911	941	946	921	929	874	936
Guasare.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total.....	1,704,643	1,811,693	1,828,421	1,819,949	1,829,967	1,844,407	1,824,642	1,803,154	1,724,818	1,717,604	1,767,582	1,814,458	1,798,625

*Figures obtained from Minister of Mines and Hydrocarbons, United States of Venezuela.

TURKEY

Prod. 300 b/d Ref. Cap. 1400 b/d

At the end of 1952 and after 30 years of looking for oil itself, the Turkish government has announced that it will be happy to have American oil companies come in and develop its potential. George McGhee, United States ambassador to Turkey, and an experienced oil man himself, made the announcement, declaring that he believes there are great possibilities for oil in Turkey. Although the Turks have admitted that their government-sponsored oil industry cannot get the job done no laws have been passed yet so that United States firms can be called in. The Turkish council, however, has announced its intention and will soon invite foreign specialists in world oil legislation to help prepare a law under which it can invite outsiders to participate in oil development in Turkey.

Ramandag, near the Syrian border, and Garzan, discovered in 1951, are the two fields resulting from government effort and their production has been limited by refining facilities.

Turkey also has big news in refining. A contract has been signed with Ralph M. Parsons, Los Angeles, to build a plant near the fields with a 6250 bbl a day capacity. This will allow development of the fields. Cost of the refinery will be approximately $8,000,000.

UGANDA

This Central African country has been surveyed by geologists of Anglo-Iranian Oil and Shell upon invitation by the government. Uganda is a British protectorate situated below the Sudan and east of Kenya.

Test drilling has been disappointing and activity has died down.

UNITED KINGDOM

Prod. 1200 b/d Ref. Cap. 540,000 b/d

Anglo-Iranian Company, which holds the petroleum rights in the United Kingdom has vigorously explored the islands. What appears to be a sixth field to be found is at Croton, near Widnes at a depth of about 1650 ft. Tests are planned for Croxeth and Ainsdale.

Crude runs are substantially below capacity. Expansion of plans has progressed rapidly in the past year. Llandarcy in Wales has 80,000 bbl capacity and is processing about 77,000 bbl a day.

Scotland's four plants total some 50,000 capacity and England's 10 plants about 410,000 capacity. Crude runs for all the United Kingdom are some 440,000 bbl a day.

UNITED STATES

Prod. 6,250,000 b/d R. C. 7,750,000 b/d

In 1952 the U. S. had a record year for discoveries, production, refining and consumption.

45,840 wells were completed; 10,571 wildcats were drilled; 2800 rigs were active; and 6,668,000 bbl of oil were processed per average day in 1952 despite the big strike in May.

URUGUAY

Ref. Cap. 25,000 b/d

ANCAP, the government oil monopoly, has carried on geophysical work and is mapping Uruguay's structures.

ANCAP refinery at LaTeja meets the demand of the country except for aviation gasoline and base oils for manufacturing lubricants.

Crude for the plant comes from Venezuela, Arabia, Ecuador, Chile, and Peru. Throughput has been running considerably below capacity.

USSR

Prod. 850,000 b/d Ref. Cap. 890,000 b/d

Output of Baku oil fields is said to have fallen sharply in the last year, which accounts for the costly offshore drilling in the Caspian Sea. A new field was announced recently from the overwater drilling.

Despite this report (through diplomatic sources) of Baku decline, there is a general inclination on the part of those making world production estimates to place production steadily higher. This follows increased exports of Russian oil products, a doubtful barometer. USSR export of materials does not mean it has ample for domestic use.

There have been for years allusions in dispatches from the USSR of the "new Baku" in the dry steppes southwest of the Urals. How successful operations are remains obscure.

One thing that does come through the Iron censorship are complaints. N. Baibakov, commissar of the oil industry, assures an AP correspondent that all is going well, but "there are many shortcomings." Drilling in some areas, he said, "has been impermissibly lagging behind."

Refining construction must have kept up with increase in oil production as exports seem to be products.

VENEZUELA

Prod. 1,800,000 b/d R. C. 360,000 b/d

Not much change has been made in Venezuelan oil production since last year when the second largest oil-producing country increased output sharply to aid in making up for the Iran shutdown.

Some 11,000 wells are producing, including about 175 drilled in 1952. Of the 11,000 producers, 6000 are in the Lake Maracaibo area and produce almost 1,000,000 bbl a day.*

Refinery runs were below capacity in general although the largest refinery in Venezuela, Shell Caribbean Petroleum's plant at Cardon, was stepping up its runs and construction will soon be completed to expand from 62,500 to 145,000 bbl a day capacity. This refinery was heavily damaged by a fire in September.

An election was held in Venezuela that left the military in control, a regime inclined to leave the oil industry alone so long as it provides the bulk of the taxes.

Creole inaugurated a crude oil price bulletin at Venezuelan deep water ports.

During 1952, construction was completed by Venezuelan Atlantic Transmission Corporation (VATCORP), owned principally by Atlantic Refining, of a pipe line for transporting natural gas from fields in the State of Guarico to Caracas, LaGuaira, Mafacay, Valencia, and other points. This main transmission line is approximately 193 miles long. In addition, about 57 miles of distribution lines were built.

Venezuelan Atlantic Refining Company constructed approximately 70 miles of gathering lines for transporting gas from field wells to the main transmission line. A dehydration plant was built at the Lechoso, Guarico terminal of the transmission line. In November 1952, construction was completed of a compressor station for handling low pressure gas in the Las Mercedes field, State of Guarico, and this compressor station is supplying gas to the main transmission line. The first deliveries of gas to industrial and commercial consumers were made about June 1, 1952.

Creole piped gas to its refinery at Caripito from the Quiriquire producing area to be used as fuel in the plant.† This saved 1400 bbl of fuel oil daily which had been consumed in the refinery, adding that much fuel oil to overseas markets.

Creole expects to spend about $100,000,000 in 1953 on new projects and expansion of its Amuay Bay refinery. The company is building a 26-in. line from Ule to Amuay, a distance of 143 miles.

YUGOSLAVIA

Prod. 2400 b/d Ref. Cap. 8000 b/d

Oil equipment from the United States, the United Kingdom, and Germany has helped raise Yugoslavia's output. Besides development of two fields, three new fields are reported‡

Five small refineries average close to 8000 bbl a day crude runs. Two new plants are planned to take care of expected production increase.

ZANZIBAR

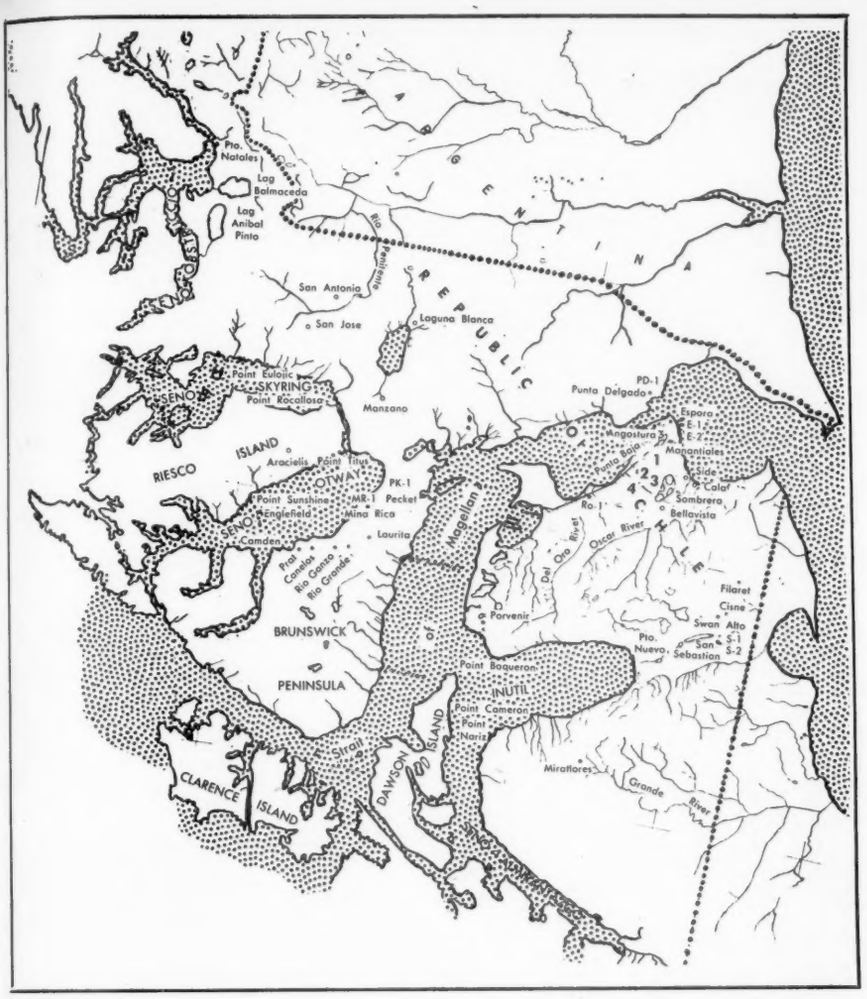
Shell-D'Arcy was reported to have an oil exploration license for this island protectorate.

*The Petroleum Engineer, October 1952, page B-108.

†The Petroleum Engineer, September 1952, page D-7.

‡The Petroleum Engineer, March 1952, page B-18.

* * *



CHILE

Oil closest to the South Pole is at tip of South America

CHILEAN petroleum was taken over by that country's government December 29, 1926. Exploration, exploitation, refining, and sale of national petroleum are carried on by the state-owned company, Empresa Nacional del Petroleo, in accordance with Law 9618 of June 16, 1950.

Geological activities have been carried out in Magallanes over approximately 5400 square miles, with 1544 square miles being detailed. Seismic tests have been made over a 772-square mile area, and 2702 square miles have received gravimetric exploration.

Exploration wells drilled to December 31, 1952, are:

Year	Well	Result	Feet
1945	Manantiales No. 1	Oil	7450
	Mina Rica	Dry	1870
	Pecket	Dry	3280
1946	Canelos	Dry	3400
1948	San Sebastian No. 1 and 2	Dry (each)	7500
	Espora No. 1	Dry	7000
1949	Espora No. 2 (Extension)	Gas	7000
	Angostura	Gas	7550
1950	Chanarcillo No. 1	Gas	7800
	Victoria Norte No. 1	Gas	7500
	Victoria Sur No. 1	Oil	7600
	Sombrero No. 1	Oil	7500
	Delgada No. 1	Gas	7850
1951	Delgada No. 3 (Extension)	Oil	7900
	Rio del Oro	Dry	10,600
1952	Ganso	Dry	9300
	Prat	Dry	5335
	Victoria Este No. 1	Dry	7628
	Sombrero Este No. 1	Dry	6632
	Punta Baja No. 1	Gas	7746
	Chanarcillo Sur No. 1	Gas	7510
	Side	Oil	6800

Total wells by fields:

	Oil	Gas	Dry	Tota
Manantiales	18	8	9	35
Espora	..	1	1	2
Chanarcillo	..	3	1	4
Victoria Norte	1	2	..	3
Victoria Sur	13	2	4	19
Sombrero	8	..	3	11
Angostura	..	1	..	1
Delgada	1	2	1	4
Punta Baja	..	1	..	1
Chanarcillo Sur	..	1	1	2
Side	1	..	..	1
Total	42	21	20	83

In addition to these wells one well was being drilled in Victoria South and two in Sombrero.

Production by fields in 1952 was:

	Barrels
Manantiales	30,528
Espora	3017
Chanarcillo	36,222
Victoria Norte	4,401
Victoria Sur	385,979
Sombrero	443,553
Angostura	4,491
Delgada	1,567
	909,758

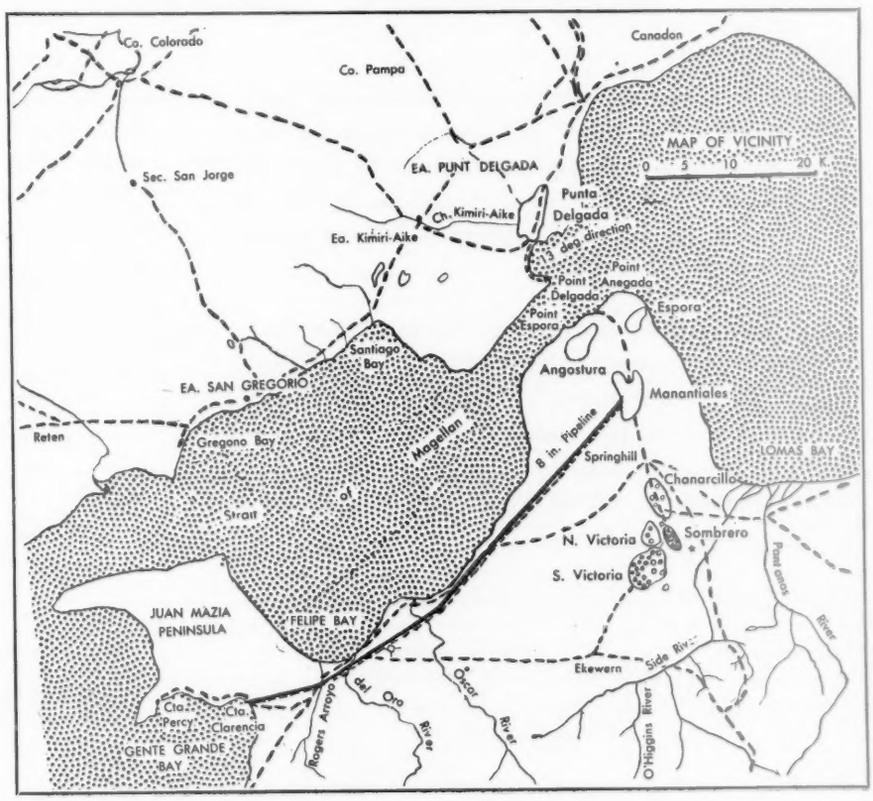
A refinery is under construction at Concon, near Valparaiso, with a capacity of 20,000 bbl per day topping, and 6300 bbl per day cracking unit. The plant was designed by M. W. Kellogg.

Construction of a gasoline plant in Magallanes was completed and operations began in June of the same year. This plant has the following capacity:

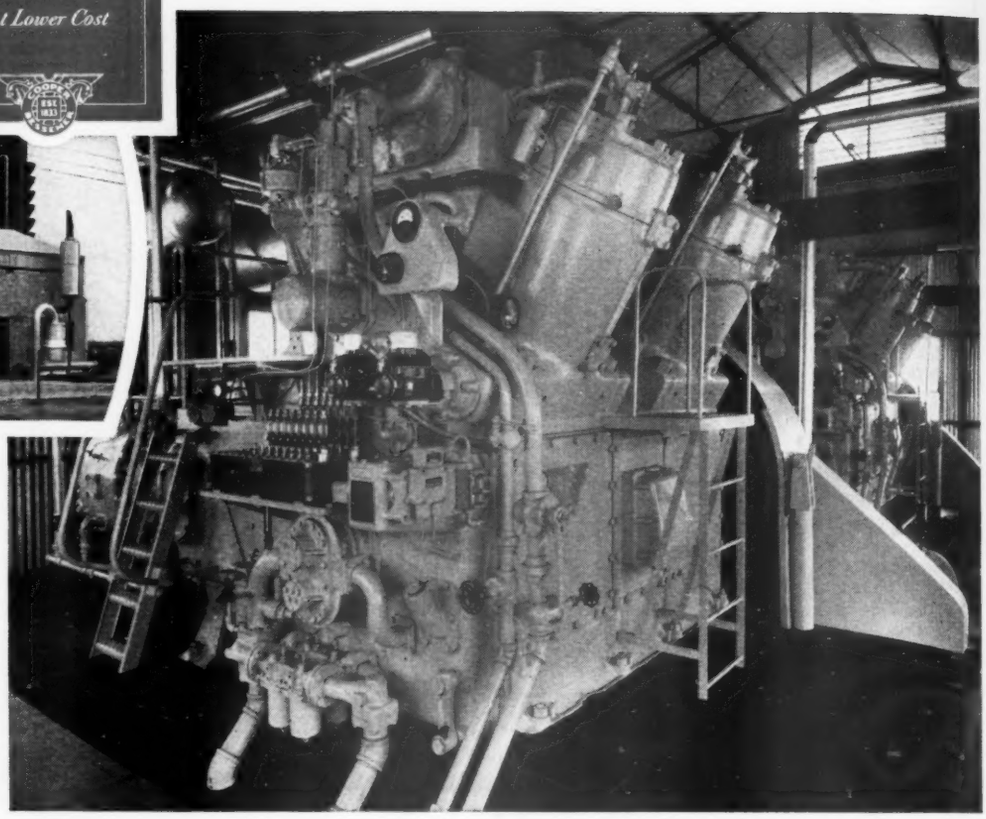
Absorption and recompression plant, 30,000,000 cu ft per day; stabilization plant, 6500 bbl crude per day; topping section, 750 bbl per day.

This topping plant will supply the demand of the Magallanes region in gasoline, kerosine, and diesel.

During 1953 exploration will continue through 4 geological parties, 3 gravimetrical, and 2 seismic crews. A new magnetometer will be put in operation, and it is expected that a total number of 30 wells both exploration and development will be drilled during the year. * * *



Another Example of Efficient Power at Lower Cost



These automatically controlled, 2-stage, 440 hp Cooper-Bessemer compressors take field gas at 20 psi and discharge at 425 psi into the pipe-line system of United Gas. Inset shows exterior of this new Universoil booster station in the West Beaumont field. Installation was handled jointly by Deerfield Petroleum, Inc., and Universal Petroleum Co., Oil Well Supply Co. furnishing all equipment.

RIGHT: Close-up of the operating ends of the modern GMV's from the crank-door side. Unusual flexibility makes these units ideal for automatic operation.

More profit in gas conservation...

...WITH GMV ONE-MAN AUTOMATIC OPERATION

WHEN a booster station practically runs itself, month in, month out, gas conservation is bound to be more practical, more profitable! And that's the success story behind those Cooper-Bessemer GMV V-Angles, shown opposite, in Universoil's new station in the West Beaumont field.

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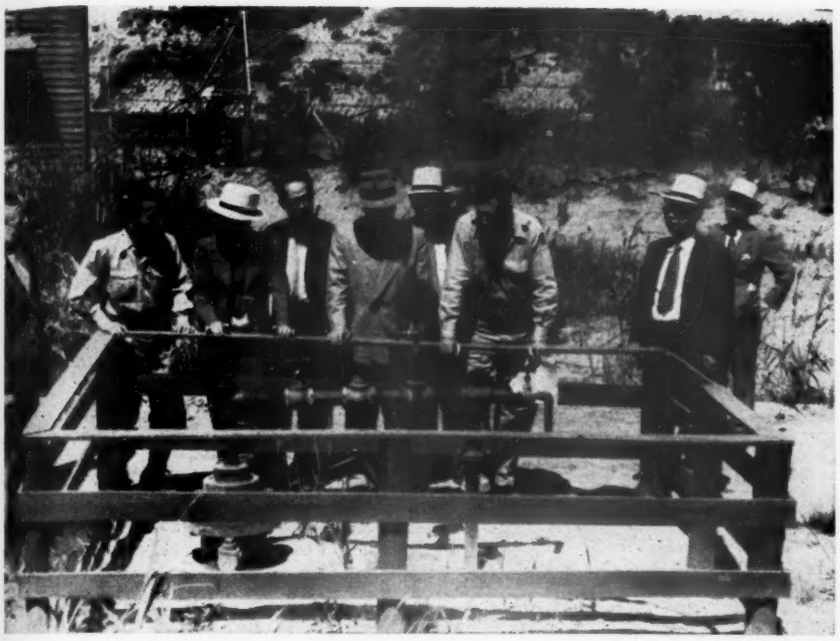

—*Photo by L. W. Stach.*

Japan's first water injection well for secondary recovery in the shallow Zone 3 of Yabase field, Akita prefecture. Inspected by Dr. Hubert G. Schenck, then chief of the Natural Resources Section, GHQ, SCAP, and Japanese Government officials.

Japan

FIRST SECONDARY RECOVERY PROJECT, A NEW FIELD, ABOLISHMENT OF OIL PRODUCTS RATIONING MARKS 1952

LEO W. STACH*

JAPAN'S production of 5850 bbl of crude daily, including 92 bbl daily of natural gasoline, from about 3000 producing wells, was 7.5 per cent less than that for 1951. The principal reason for the decrease in production was the enforcement of conservation measures after the serious over-exploitation at excessive gas-oil ratios during 1951 of the deep reservoirs of Yabase field. Because of this excessive production, decline rates shot rapidly to nearly 30 per cent per month in wells producing from the deep reservoirs, but some of this loss was made up by the successful results of new exploitation drilling of the productive area of these deep reservoirs. Of the total annual production of 2,133,568 bbl, 2,078,405 bbl, or 97.4 per cent, was produced by the Teikoku Oil Company. Production of oil field gas was about 2,230,000 cu ft daily and natural methane gas produced from saline artesian water averaged 6,540,000 cu ft daily. Processing of methanol from the methane gas was begun in the latter half of 1952, in Japan's largest methane gas field at Niigata City and a vinyl chloride plant is expected to begin operation in 1953 utilizing methane gas.

A notable exploitation development during the year was the successful application of secondary recovery by water flooding in the shallow depleted reservoirs of the southern half of Yabase field. Profitable results obtained in this area have stimulated the development of a much expanded program for secondary recovery projects in 1953 and it can be expected that production of crude obtained by secondary recovery will account for an increasing percentage of Japan's production of crude during the next few years. The quantity of crude produced during 1952 by secondary recovery is estimated at about 48,540 bbl, or 2.3 per cent of the total production. This includes production from the oil mine at Higashiyama where oil has been obtained for the last 10 years by seepage from gallery walls, and inclined bore holes drilled into the oil sands from the galleries that are driven through the oil sands about 800 ft underground. Gas injection for pressure maintenance was also applied in the deep reservoirs of Yabase field.

The most notable discovery of the year was the successful completion of a wildcat on the nose of a large anticline in the Shinjo basin of Yamagata prefecture. At least three pay zones were penetrated between 400 and 1200 meters in this well and the initial production was about 100 bbl daily. The most productive regions were hitherto restricted to the basins bordering the Japan Sea in Northwest Honshu, so that this first discovery of commercial production in an inland basin enhances the prospects for future production from other inland basins along the same general trend. Deeper pool tests drilled in the central and southern areas of Yabase field proved the existence of greater thicknesses of pay zones than in the same reservoirs of the north part of Yabase field where the deep zones are now almost fully drilled up.

The activity of the smaller producing companies was limited during the year. The Nippon Mining Company, which operates a refinery near Akita, continued its wildcatting program by drilling on a lease in Yamagata prefecture, but all its efforts of the last few years to discover new production have been unsuccessful to date. The Daido Oil Company, which is still the largest producer among the small independent companies, is facing difficulty because of declining production. A new producing and prospecting company, the Nippon Oil and Mining Company, was established in October 1952 to develop Hibiki oil field in Akita prefecture and to prospect the Hachikoku anticline in Niigata prefecture.

The conflict over the introduction of conservation and rational exploitation of the deep reservoirs in Japan's largest oil field at Yabase, which contains more than 50 per cent of Japan's proved reserves of crude, was finally solved by the promulgation of the new Petroleum and Inflammable Natural Gas Development Law in June 1952 and the resignation in September of the entire board of directors of the Teikoku Oil Company, which produces more than 97 per cent of Japan's crude. Much credit is due to the Japanese Government for their recognition of the necessity for promoting proper conservation practice to conserve Japan's slender resources of crude oil, which are only sufficient to supply about 10 per cent of current requirements of petroleum for the national economy.

The most important legislative event of the decade, with respect to the petroleum producing industry, was the passage of the Petroleum and Inflammable Natural Gas Resources Development Law after three years of bitter political controversy. Apart from the rigid conservation measures and regulations for unit operation of adjoining leases and proper well completion contained in the law, provision is made for subsidies for secondary recovery operations and for exploration survey and drilling. Appli-

*Technical consultant for oil and natural gas development in the Far East, Box 121, Tokyo, Japan.

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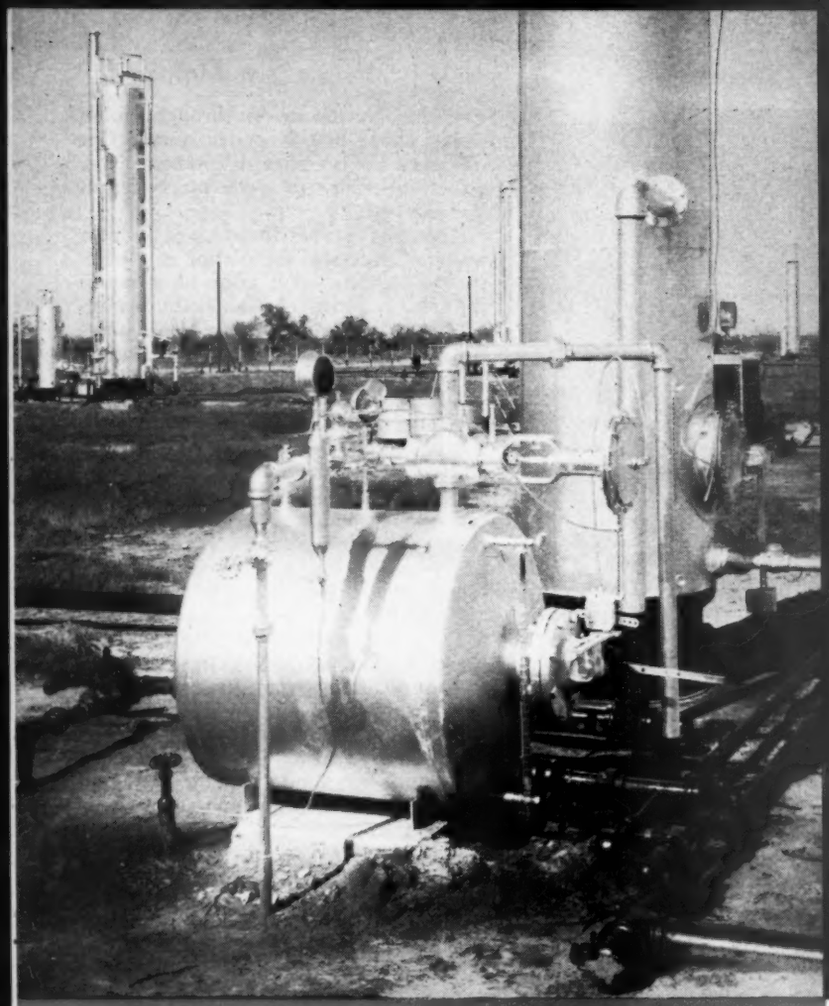

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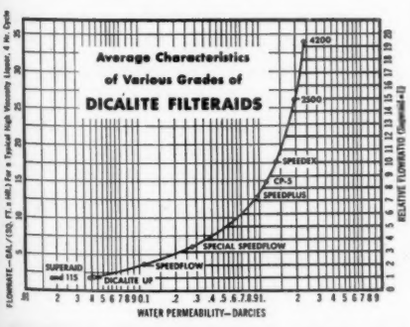

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cations for subsidy will be screened by a special technical committee, the Petroleum Resources Council, which will act as an advisory technical council to the Mining Bureau on these matters and on other technical matters connected with the administration of the new law.

Total refining capacity is now about 124,000 bbl daily, of which 107,000 bbl daily is credited to the refineries operating on the Pacific Coast of Japan solely for the refining of imported crude. Expansion of refining capacity on the Pacific Coast from about 61,000 bbl daily in 1951 resulted from introduction of new capital and technological assistance provided by foreign oil companies that strengthened their affiliations and holdings in the Japanese refining companies during 1951 and 1952. Imports of crude during 1952 averaged about 63,000 bbl daily, of which about 78 per cent was imported from dollar areas (mostly from Arabia) and 22 per cent from sterling areas.

Domestic production was sufficient only to supply about 30 per cent of the refining capacity of the Japan Sea Coast refineries, which were designed primarily for processing local crude. Some imported crude was supplied by affiliated companies to the refineries for processing.

Now that refining capacity has about reached saturation point for fulfillment of the requirements for petroleum products in Japan, it is expected that expansion of refining capacity will be limited in the future. Rationing of gasoline and lubricants was abolished early in 1952.

* * *

New Colombian Oil Laws Favor Industry Growth

Colombian oil industry made several strides forward in 1952, but most encouraging was new laws passed by the government favorable to oil development.

A decree passed on pipe lines provided that pipe lines will not revert to the government, but the government may purchase any line after 30 years of the contract. Tax was increased from 2½ per cent to either 4 or 6 per cent depending upon the location. Operating contracts will be 50 years instead of 30 years and can be renewed each 20 years. Pipe line taxes are flexible and will depend upon economic conditions and proposed locations of the lines.

The Colombian government passed a law increasing depletion allowance from 5 per cent to 20 per cent of gross income, not to exceed 10 per cent of net income. Concession bids if accepted, must be signed as contracts if so desired by the Government, and surface fees were increased where rigs are not maintained active. Surface fees during exploitation are at the rate of about 48.6 cents per acre per year. Royalties were increased approximately 2 per cent.

Legislation removing all duties from material used for exploratory operations was especially important to oil companies. Custom duties in general were increased and those on oil equipment, materials, machinery, etc., were raised from 8 to 20 times the former duties.

5 reasons WHY

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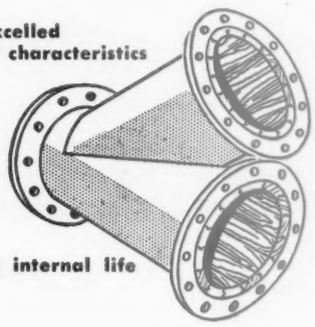

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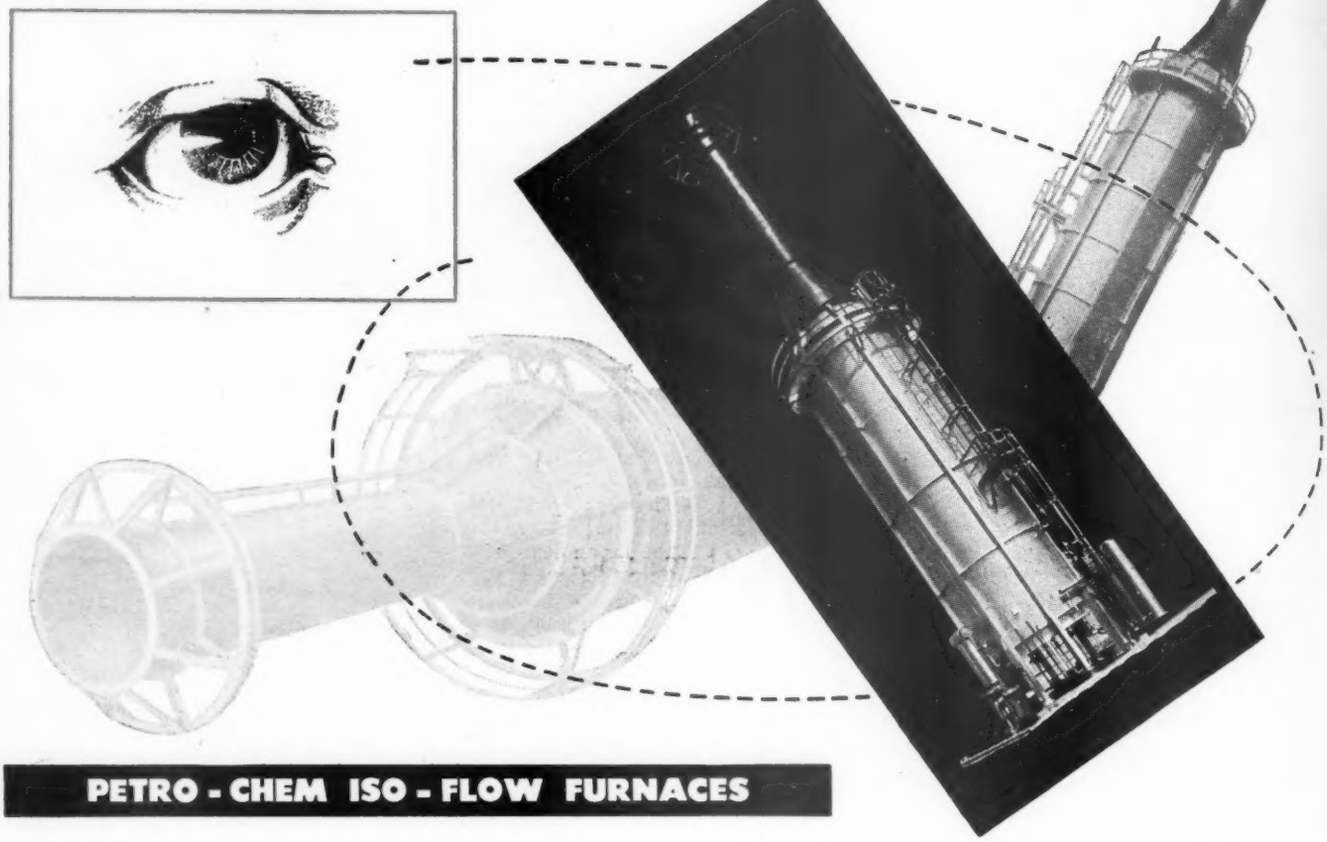

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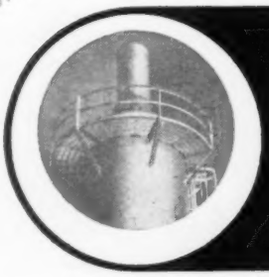

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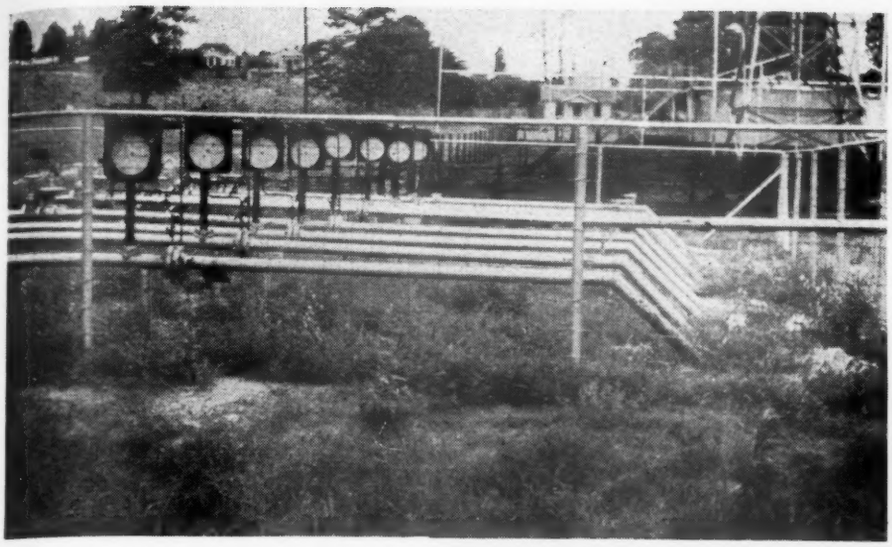
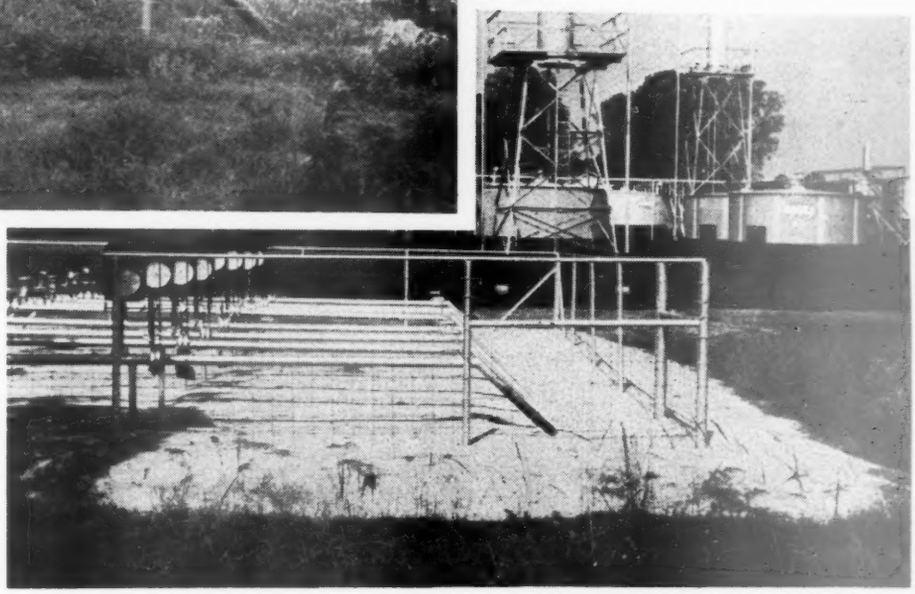


Meter bank in East Texas with Bermuda grass on a sand fill. This area had been scalped three times a year.



Seven and a half months after a single application of crude borax.

Chemical Weed Killers Aid Good Housekeeping

Plant controls are a safe and quick way to eliminate fire hazards and to reduce maintenance costs

C. W. SCAMMAN

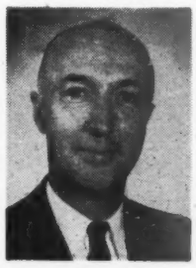
PROBABLY no other industry is quite so vitally concerned with a fire hazard as is the oil business. All along the line of travel of a barrel of oil from the producing well to the filling station pump there are areas where a fire hazard becomes of paramount importance and, almost without regard to cost, such hazards must be eliminated. No growth of vegetation sufficient to support a grass fire can be tolerated in close proximity to any container of oil or any of its products from the standpoint of fire hazard alone. Besides that, the petroleum industry is notably neat in all its operations and has always exhibited commendable pride in the appearance of its properties. The general public would have difficulty in visualizing an oil operation with brush and weeds growing around producing wells or storage tanks of any description.

A weed is any plant that grows where it is not wanted. Thus, in speaking of the area around a producing well, for instance, we may refer to any grass, broad-leafed annual, or brushy growth as a "weed." The control of these weeds has been standard practice throughout the industry for many years, the expense generally being considered as maintenance cost. Certainly the most basic of all of the varied functions of the petroleum engineer is to devise ways and means of cutting costs necessary to the production and processing of petroleum. The present trend is that maintenance costs have been demanding more atten-

EXCLUSIVE

The Author

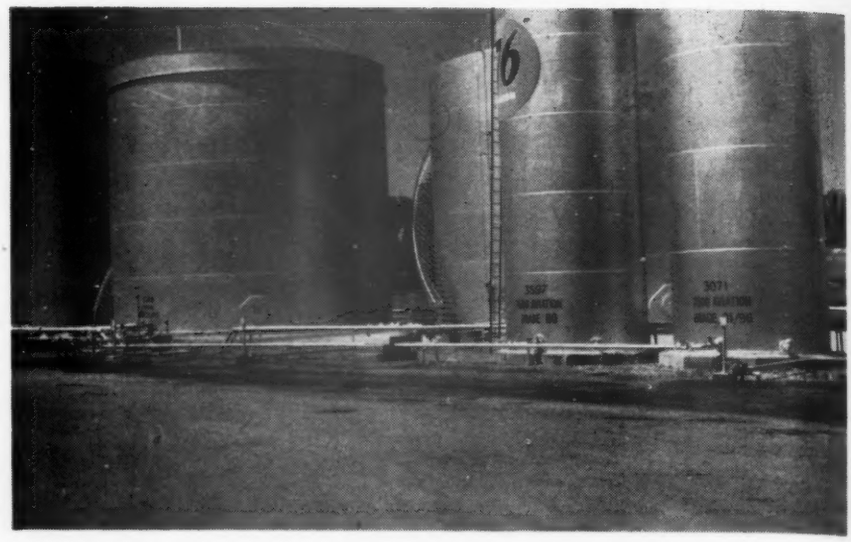
C. W. Scamman is sales engineer, mud and chemical division, for Houston Oil Field Material Company. A graduate of Rice Institute in 1925, he did general petroleum engineering as assistant to Stanley Gill, consulting engineer, until 1941. He later joined J. S. Abercrombie Company engaged in engineering and purchasing until 1946, when he resigned to take his present position with Houston Oil Field Material.



tion, principally because of a general increase in labor wages. This has placed manual weed control among the fastest rising expense items. The chemical industry has accomplished much within recent years in developing chemical aids to abate or alleviate this unavoidable expense factor.

In the next year, the oil industry will spend a sizable sum of money on weed control. For, although there are few large areas to be denuded of vegetation, the aggregate of all the little bare patches required becomes a tremendous area. A quick glance at the record will show why this sum need not now be as great as in the past, in spite of general raises in wages and increases in material costs, freight charges, etc.

The first, oldest, and most obvious method of keeping a piece of ground bare is to get out there and chop with hand tools. This is becoming a bit old fashioned. Even hiring somebody else to do it is becoming out-moded. So, with the comment that manual control always was expensive, is now more expensive, and undoubtedly will become most expensive, let us consider chemical controls.



California tank storage area kept clear and safe with borax spray applications.

Three Groups

Weed killing chemicals may be generally classified into three groups, according to the results desired. There are chemicals that kill by contact, an application that might be called chemical mowing. These are generally liquid for spray application. Then, a second group of awe-inspiring selective killers, mostly "hormone-type," used both as dusts and as sprays. Last, the soil sterilants — those preparations that sterilize the soil against any growth of vegetation for periods of time contingent upon many varying factors.

The first group mentioned generally consists of aromatic hydrocarbon solutions called contact herbicides, which are designed to kill top grasses and weeds down to the crown of the plants, but not to kill the roots. They have wide application, particularly where erosion of ditch banks or fire walls is to be avoided.

The second group, the selectives, is a fascinating, still developing group of hormone type chemicals. In spite of the almost miraculous results already standard practice, we can say in the words of the showman "we ain't seen nothin' yet." The leader of this group, both in point of time and in present general use, is 2-4 Dichlorophenoxyacetic acid, known as "2-4D." Its effectiveness is confined to those plants that have ribbed leaves, and in which the metabolism processes take place partially in the foliage. Grasses do not fall in this category, and, because nearly all grains are grasses, its widest use has been in agriculture for weeding out rice and wheat fields. Undesirable brush in pasture lands has also been quite successfully controlled by members of this group.

The group of soil sterilants is the one that is of the widest interest to the oil man, for patches of bare ground are maintained as standard practice throughout every branch of the industry. Let us consider this group further.

Application of borax spray on lease in Signal Hill, Long Beach, California.

Economic Factors

It can be generally stated that any chemical compound known will kill off plant growth when put on the soil in sufficient quantities. Even the best of fertilizers will sterilize the ground for some time if applied heavily enough. It thus remains for us to examine the list with an eye to economic factors. If we are going to use chemicals, the per square-per lasting time cost of maintenance is going to have to be less than hand scalping costs for the same area for the same time.

The principal questions to be answered in selecting the chemical to be used are: 1. Is it readily available and is the supply dependable? 2. Is it flammable itself, or will it support combustion? 3. Is it corrosive to ferrous metals? 4. Is it poison to animals (especially to humans)? 5. Can it be applied readily and simply? 6. What is the relative cost to keep a plot of ground bare for a year?

The most common of all common chemicals is common salt, sodium chloride. Salt will give a favorable answer to all but two of our questions: There is plenty of it; it will not burn nor support combustion; it is not a poison; it could be applied by scattering on the

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ground or spraying. But it does accelerate corrosion of iron and steel; and, in spite of its being almost as cheap as dirt, it costs more than some other chemicals for the same results, for so much must be used so often, due to its high solubility.

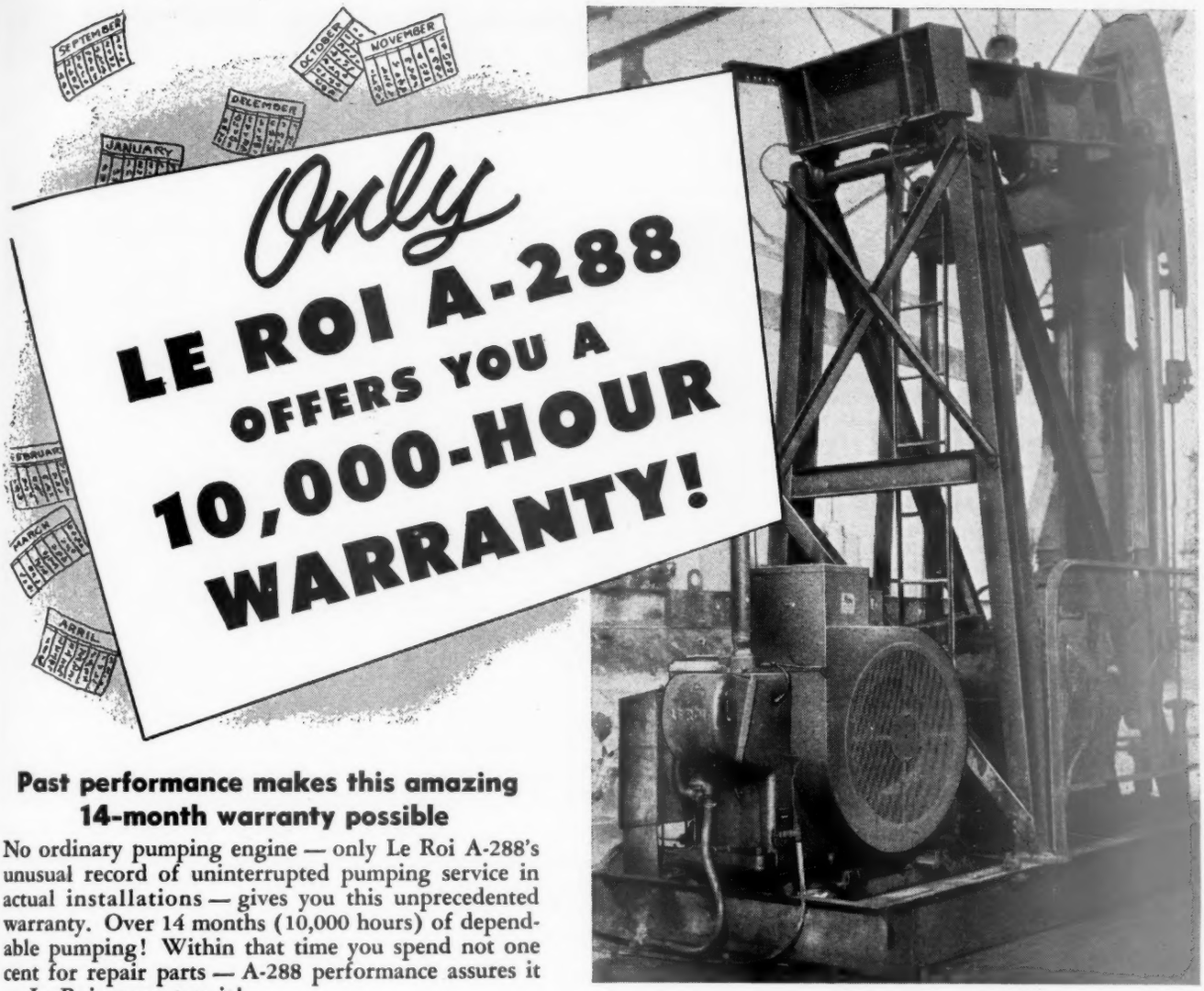
On a producing lease, one of the most readily obtainable chemical compounds is B S and W — (bottom sediment and water). Some lease tanks in some oil fields will produce enough B S and W to keep their own sites clear of vegetation if it is disposed of by pouring on the ground often enough. The use of any crude oil to augment the supply of B S and W is, in the present circumstance of supply and price, definitely to be condemned — that would not be conservation of either resource or money.

Some of the longest used and most efficient vegetation killers are arsenicals. Their extreme toxicity practically precludes their use in the oil industry, which to so great an extent occupies the same lands that are grazed by animals.

A group of chlorates also has been found very effective. They are oxidizing agents, however, and consequently would be expected to accelerate corrosion of metals or combustion of organic matter with which they are mixed or in contact. Recently mixtures of chlorates and other chemicals as additives have been very successful in the control of heavy brush. Other new chemicals are constantly being brought forward; for instance, one of the sulfonates has had wide application in the control of brush along right of ways. An urea compound is emerging from the experimental stage with some rather spectacular results, what is comparatively a mere trace in the soil being effective in some applications.

The chemical that has found the widest application to date in the oil industry is crude borax. It fulfills to a remarkable extent all of the requirements stipulated. It is available in practically unlimited quantities; it is not flammable nor will it support combustion. Borax compounds are not only non-corrosive to steel but have wide application as inhibitors of corrosion. The toxicity of borax is well covered in a paper by E. C. Owen of the Hannah Dairy Research Institute, Kirkhill, Ayr: "The Excretion of Borate by the Dairy Cow" (Volume 13, No. 3, March, 1944, printed in Great Britain). Test rations containing varying amounts of boron were fed to dairy cows. The most careful and accurate scientific records were kept throughout of total input and output of boron compounds. Analytical recovery from the various excreta accounted for from 98 per cent to more than 99 per cent of the input. We are interested here in only a couple of the conclusions reached. "No adverse effects on the health of the animals were observed as a result of the prolonged borate feeding." Then, as a warning to farmers using barnyard fertilizers' comes this paragraph pertinent to our subject:

"While traces of boron are needed for the healthy development of most plants, ... this element is extremely toxic if



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- Patented, closed "vaporizing-condensing" cooling system requires almost no make-up water — keeps temperatures uniformly high and prevents sludging even in sour gas areas.
- The A-288 is the only pumping engine to be recommended by one major user for continuous service *unattended for up to two weeks at a time.*
- Short, solid, properly counterbalanced crankshaft is 5" in diameter, has extreme overlap between crankpin and main bearing journals for added strength.
- No shut-down is required for inspection or adding oil.
- Heavily constructed and internally ribbed integral crankcase and base is rigid to resist distortion due to temperature differences or faulty mounting.

Send the coupon today for up-to-the-minute details on the new A-288 10,000 hour warranty. And take a look at the list of Le Roi distributors, an important cog in Le Roi's 3-way partnership, that means more efficient service to you.

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Western Machinery & Engine Company — Centralia, Illinois and St. Louis, Missouri.

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P-117

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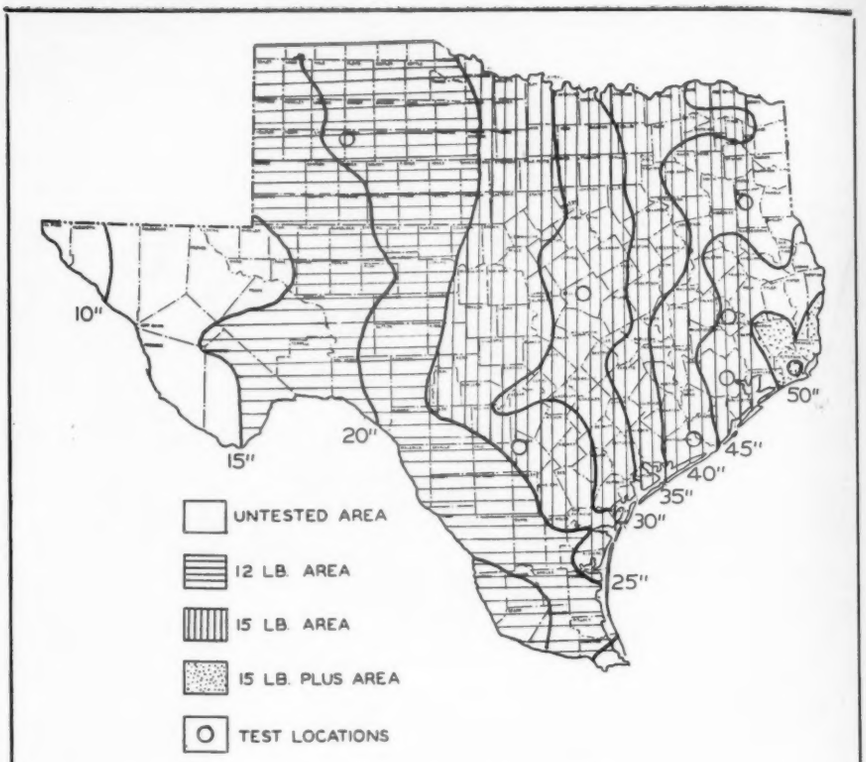

Rainfall map of Texas showing minimum efficient rates of application of crude borax.

present in large amounts. Thus the toxic level for cereals and grassland is generally considered to be 5-10 lb of borax per acre, while dressings of 12-15 lb are sufficient to cause marked yellowing in beans and other crops. Moreover, on certain types of soils, the toxic effect of boron is cumulative, and it is practically impossible to eliminate it from such soils once it has been applied.[3]

The application of crude borax is by the simplest possible method. It is usually applied by sowing by hand from a pail or bucket. Spreaders are available for large scale use, but for the many different, relatively small areas where

TABLE 1. Results of crude borax test plots in Texas.

Location	Date of Test	Lb/100 Sq Ft	Site	Soil Type	Per Cent Control 1 Yr Later	Per Cent Control 2 Yr Later
Brazos County.....	Oct. 1949	6	Fence line	clay loam	70	50
		8			70	50
		10			85	60
		12			90	80
		15			99	95
		18			99	95
		20			99	95
San Jacinto County...	Feb. 1950	12	Fire lane	heavy clay	90	50
		15			99	80
		20			99	95
Jefferson County.....	Dec. 1950	12	Pipe alley	oyster shell clay	85	30
		15			99	70
		18			99	85
		20			99	85
Harris County.....	Oct. 1949	12	Tank Battery	clay	85	80
		15			99	90
		20			99	95
Matagorda County...	Nov. 1949	12	Tank Battery	silt loam	85	70
		15			99	85
		18			99	95
		20			99	95
Victoria County.....	Nov. 1949	12	Gas well	silt loam	90	80
		15			99	95
		20			99	99
Atascosa County.....	Feb. 1950	12	Tank Battery	clay	90	80
		15			99	95
		20			99	99
Karnes County.....	Nov. 1949	12	Tank Battery	caliche	95	90
		15			99	95
		20			99	97
Jim Wells County....	Dec. 1949	10	Pipe rock	sand	95	80
		12			99	85
		15			99	95
Hidalgo County.....	Dec. 1949	8	Fence line	sandy loam	90	50
		10			95	50
		12			99	60
		15			99	75

Illustration of a typical hand application of crude borax. Hand applications are usually made with an ordinary bucket held under the arm and a side under hand motion to spread.

the petroleum industry is using borax, the bucket is easily the quickest and cheapest apparatus. The coarse granular material is not easily blown by wind, nor washed about by rain. It is grayish white, which contrasts with the soil well enough that an even distribution can be made of the proper amount of the material with very little practice.

Application of this type of material should be made during the winter months when precipitation is most dependable. As it is applied dry to the soil, rainfall is necessary to carry it into the ground where it attacks existing seeds and root systems; and where it remains available to contact seeds that may invade the area at a later date. Actually, the borax is an additive to the soil. If two or three successive annual applications are made, the boron content of the treated area is built up so that an indeterminate carry-over is obtained, as was indicated in the dairy paper previously quoted.

Prior to application it is desirable that the area to be treated be scalped free of vegetation. If scalping is not feasible, however, the usual results can be obtained by increasing the rate of application.

The effective life period of an application of a weed-killing chemical is largely determined by two factors; precipitation, which washes away the chemical by leaching action; and soil permeability, which affects the rate of leaching-out. A given amount of rainfall will carry away the chemical at a faster rate in a loose, unconsolidated and therefore permeable soil. Generally speaking, sandy or rocky soils would need a heavier application than clayey earth.

The average yearly amount of rainfall in the state of Texas increases from West to East across the state, as is shown in the accompanying map. The contours, in increments of five inches, are based on U. S. Weather Bureau data prior to 1949. A representative few of the test stations throughout the state are shown in approximate location on the map, and data for two years observation are shown in Table 1.

It is to be considered that 85 per cent control is safe from a fire hazard standpoint. Because of unsightly appearance, however, most operators prefer to spot treat the second year when control is 95 to 99 per cent. It is interesting to note that compensating factors make a single recommended efficient rate applicable for a very broad area. Thus, in Southeast Texas, where the rainfall is up to 50 in., a tight clayey soil tends to hold the boron from being washed out; and the same 12 lb per 100 sq ft for scalped areas and 15 lb for areas that have not been cleaned, can be recommended for the area back toward Central Texas where the average rainfall is 25 in. but the soils are generally loose, rocky, and sandy deposits. As is shown in Table 1, a rate of 12 lb per 100 sq ft is quite efficient in areas of less than 25 in. of rain per year; control of 95 per cent after 2 years is quite satisfactory, even though they were drought years.

These rates of application will be effective on perennial grasses, probably most difficult to control of all vegetation. Johnson grass, Dallis grass, Brome and Fescue all are controlled at the 12 to 15 lb rate. A rate as little as 4 lb will kill broadleaf annuals and poison ivy.

These rates of application result in costs for chemical approximating fifty cents per square on the average. Since hand chopping will run close to a dollar per 100 sq ft, the first application will cost half again as much as though the borax had not been used. But the chemical application will last at least a year, whereas hand cutting would need to be done at least three times in that year. So a saving of about 50 per cent is apparent by the use of chemical control. A number of companies after having kept careful records have reported costs cut more than 50 per cent.

Chemical control then, will cut labor costs, eliminate fire hazards, make working areas more readily accessible, eliminate possibility of harboring dangerous insects and reptiles in working areas, eliminate contributors to corrosion, add to the good housekeeping methods that are typical of the petroleum industry. It is apparent that chemical control of weeds and grasses is a must with every well developed maintenance program in any phase of the oil industry. * * *

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Petroleum Profile

DAVID E. DAY

Vice President

Richfield Oil Corporation

"I am one of the few people you ever heard of who was born in Washington, D. C., (back in 1896, that was)," is the not-ordinary way by which David E. Day, veep of Richfield Oil Corporation, outlines his nativity and his life span, all the grown-up part of which has been spent in the service of the petroleum industry. An active member of the staffs of the U. S. Geological Survey and the Bureau of Mines for more than three decades, Day's father is well known to the petroleum industry, in his own right.

Growing up near Johns Hopkins University in neighboring Baltimore, young Dave spent his first college year at Hopkins' College of Engineering. Intent on geology as a major study, he then transferred to the Mid-West and Wisconsin University, graduating there in due time in his favorite science.

It was more or less of a tradition in those days for a fresh graduate to join some group such as a Bull-gang, the very thing he did in 1915 in Coalinga, California, as a roustabout. Aftermath to that experience came his Wisconsin sojourn, up to 1918 when that seat of learning granted him a Bachelor of Arts degree in geology.

Since that time the list of jobs and work types he has followed is very nearly a roster of the major activities of the industry. Successively he became rock hound; driller, pumper, pipe line operator. Engineering, refining, research, marketing, "and cleaning sump holes" occupied his energies in turn. Twenty-two states, France and Canada saw his work during this period up to 1923, when he joined Richfield after returning to California in 1919, "and have been here ever since (with a few months off for good behavior)" to quote his summary.

A refinery engineer's title in 1923 and following years can and generally does mean running the gamut of refinery operational problems, playing Aspirin to innumerable headaches, which is without doubt the major reason why he became vice presidential assistant in 1936. Only a man with long experience in a plethora of problems can long survive such a job, but continue he did; result being that he was made vice president of manufacturing and pipe line operations in 1945. Deponent sayeth not if his promotion meant that "he only has to sweep *half* the office each day," as was reported by another oil company manufacturing vice president colleague when elevated to the bigger job. But so stands the record, and his position as of the new year, 1953.

As is inevitable with an active and competent refining executive, Dave Day has been and is a leading member of industry technical and cooperative organizations. He is a director of Cooperative Research Council, that only-one-of-its-kind-in-the-world that performs in inimitable efficiency the indispensable job of correlating the development work of the refining, automotive, and aviation industries in fuels and lubricants. Member of the API Refining Division's general committee, in 1951 he was its secretary. He is a member also of several oil industry committees and cooperating bodies on the West Coast, always on the practical side, living with "Things as They Are."

Typically a family man, Day's "chief hobbies are boasting about my granddaughter and the climate and scenery at my new home down at Three Arch Bay" on the South Coast, Southern California area. Supplementing these all-important considerations is a "putterer's" tool shop to keep the hands in on skills learned earlier. A "pot and box" garden receives the same careful attention to detail as is given to the weightiest petroleum refining problems, the garden to be relegated to second place at least on the first signs of a game of gin rummy, pitch, or cribbage, those ancient relaxations of prince and peasant alike.

XUM

International Oil Operations

In this modern age man is dependent to a large degree upon oil. Without the present day producing capacity the clock would be set back one hundred years. It is only in recent times that the know-how has been developed to produce, to refine, and to use the products in such a variety of ways.

The demand for petroleum has increased. For example, today the average global production is 12,339,000 bbl per day as compared to 407,000 bbl per day in 1900 or 7,113,000 bbl per day in 1945. In just over 50 years crude production has increased by 2930 per cent and during the last 8 years by 73 per cent.

The proportion of the world daily output by various geographical areas is as follows: North America 54 per cent. South America 17 per cent, Middle East 16.9 per cent, Russia and satellites 9 per cent, Far East 2.6 per cent, and Europe 0.5 per cent. It is of interest to note, and as a tribute to the system of private enterprise, that the bulk, 71 per cent, of the present day world production is concentrated in the Western Hemisphere, and that the United States accounts for one-half of the world's total crude. Although the Midlde East produces only 16.9 per cent of the world total its proved reserves are the largest and reach almost the 65 billion barrel mark. The North American proved reserves are approximately half this amount.

On reviewing international oil operations for 1952 it is observed that the loss of Iran's 660,000 bbl per day to the world markets was absorbed by a step-up in production from other Middle East sources and from America and Venezuela. Saudi Arabia the largest producing country in the Middle East and fourth in the world produced 859,000 bbl per day. Canada increased production by 37,000 bbl per day to make a daily average of 180,000 bbl. The expansion of Canada's oil industry during the past year can be summarized as record breaking achievements. The immediate production objective is Canadian self sufficiency "on balance" and the long range policy is to export.

Oil fields in the Far East were shattered in the wake of World War II and the gigantic effort of reconstructing and the engineering required to place the oil fields back into operation have showed successful results. The average production in 1952 was 300,000 bbl per day, which was an increase of 27,000, or 10 per cent, over the 1951 daily output. In South America, Venezuela's production averaged 1,800,000, bbl per day.

The growth of international petroleum has not been simple, indeed, it was complex. The future demand for petroleum is calculated to increase steadily. This means that more oil must be found. Therefore, more geophysical surveys are necessary, more wells are to be drilled, and more wells are to produce. The industry from an international standpoint needs to expand and the desire of operating companies is to meet this demand. There is, however, a growing tendency that foreign operations are becoming befogged by nationalistic movements. The feeling of "this is our oil and why should 'they' take it away" is motivated and flamed into the thoughts of many. Such planted indoctrinations will hamper progress, moreover, it will restrict severely the economy of an oil producing country.

Capital will be invested only where an atmosphere of reliability exists, and where sound laws of economy are upheld. Generally speaking it takes 5 years to develop from the discovery well stage to that of a proved oil field. How long does it take to find a discovery well? There is no answer. It may take 2 years or even 20 years or maybe never. Therein lie major risks, namely, the expenditures that are necessary to search for oil, and if oil is found how much more is to be spent in the hope of having a successful oil field. By any yardstick the outlays are vast—millions and millions of dollars. No operator would make a venture in the full knowledge that when he has developed a successful enterprise he will have to forfeit the business.

It is hoped that for the good of mankind an intelligent outlook will prevail by all concerned in international petroleum developments.—J. M.

advantages of BAKER Stage Cementing

You can save casing by Stage Cementing the Baker way, because with *only* one string of casing you can cement off at the shoe *and* shut off surface water. Or you can cement a well with *two producing zones* and be assured of uncontaminated cement for the upper zone. And you *never* need risk breaking down a comparatively weak formation by high cementing pressure and the extreme weight of a long cement column.

IT'S SIMPLE, SPEEDY AND SAFE to perform two-stage cement jobs with Baker Stage Cementing Collars (Product No. 200-F) in combination with other Baker Equipment. In addition to positive, mechanical closing of the cementing ports upon completion of the second stage, you are assured of these outstanding advantages:

1 After the second stage has been completed, an external steel sleeve with an oil-resistant synthetic rubber seal provides positive closure and prevents passage of fluid between the inside and the outside of the casing, regardless of the condition of the cement job at that point.

BAKER STAGE CEMENTING COLLAR

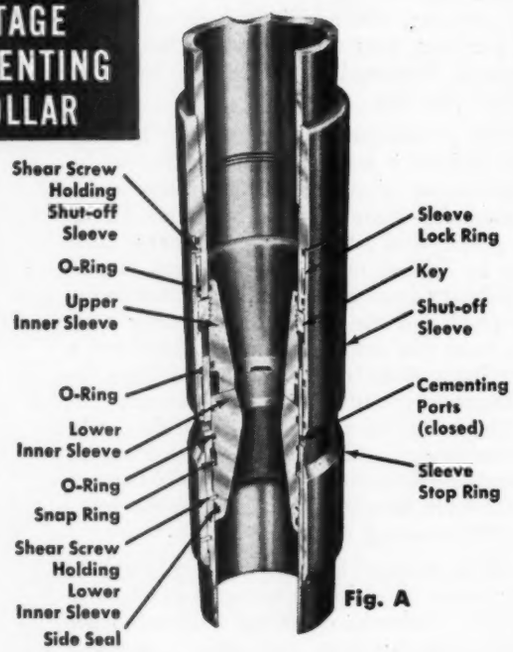

Fig. A

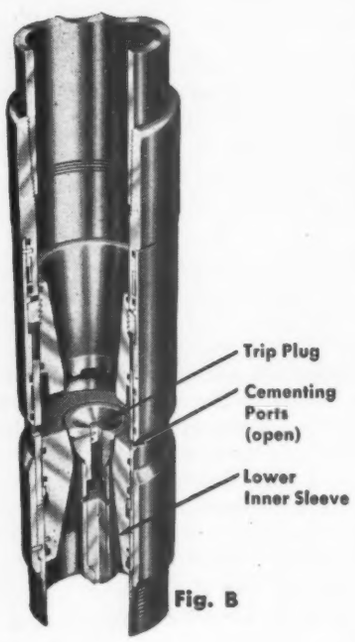

Fig. B

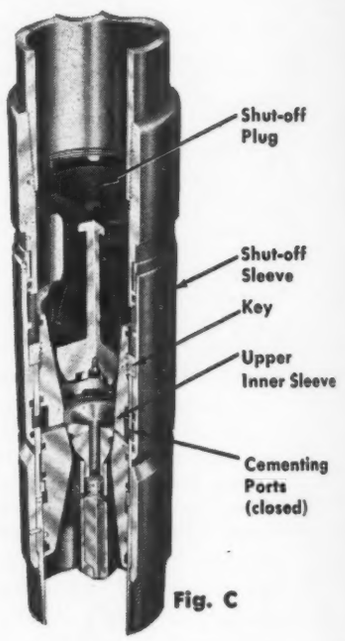

Fig. C

Fig. A—Ready for cementing the first stage. The cementing ports are covered by the Lower Inner Sleeve which is held in position by shear screws; shear screws also hold the Shut-Off Sleeve above the cementing ports. The Baker Flexible Cementing Plug (shown on opposite page) will pass through the Stage Collar without shearing the screws holding the Inner Sleeves.

Fig. B—Ready for cementing the second stage. After the Trip Plug is seated, application of hydraulic pressure shears the screws holding the Lower Inner Sleeve which moves downward, thus uncovering the cementing ports. The Trip Plug prevents passage of fluid into the casing below, and cement pumped into the casing will now pass through the cementing ports for the second-stage cementation.

Fig. C—Second-stage cementation is completed. The Shut-Off Plug has been pumped down the casing and pressure applied to shear the screws and move the Shut-Off Sleeve downward to close off the cementing ports. Note how the Sleeve Lock Ring has expanded to lock the Shut-Off Sleeve in position permanently covering the cementing ports.

See opposite page for details of operation.

2 The cementing ports of the Stage Cementing Collar may be opened at any time after completion of the first stage, and fluid may be circulated through the stage collar for any desired length of time before starting second-stage cementing.

3 Operation of the stage collar is effected by fluid pressure applications only, and no movement of the casing is required after the first stage of the cementation has been completed.

4 All internal parts of the Baker Stage Cementing Collar are constructed of readily drillable materials, and when drilled out there are no sharp shoulders or irregularities to interfere with the subsequent passage of tools through the collar.

5 Since the steel Shut-off Sleeve is on the outside of the Stage Cementing Collar, there is no possibility of accidentally opening the cementing ports when drilling out the internal mechanism, or later when bits or casing scrapers are run through the collar.

Here's how a typical **two-stage** cementing job is performed with the **Baker** Stage Cementing Collar

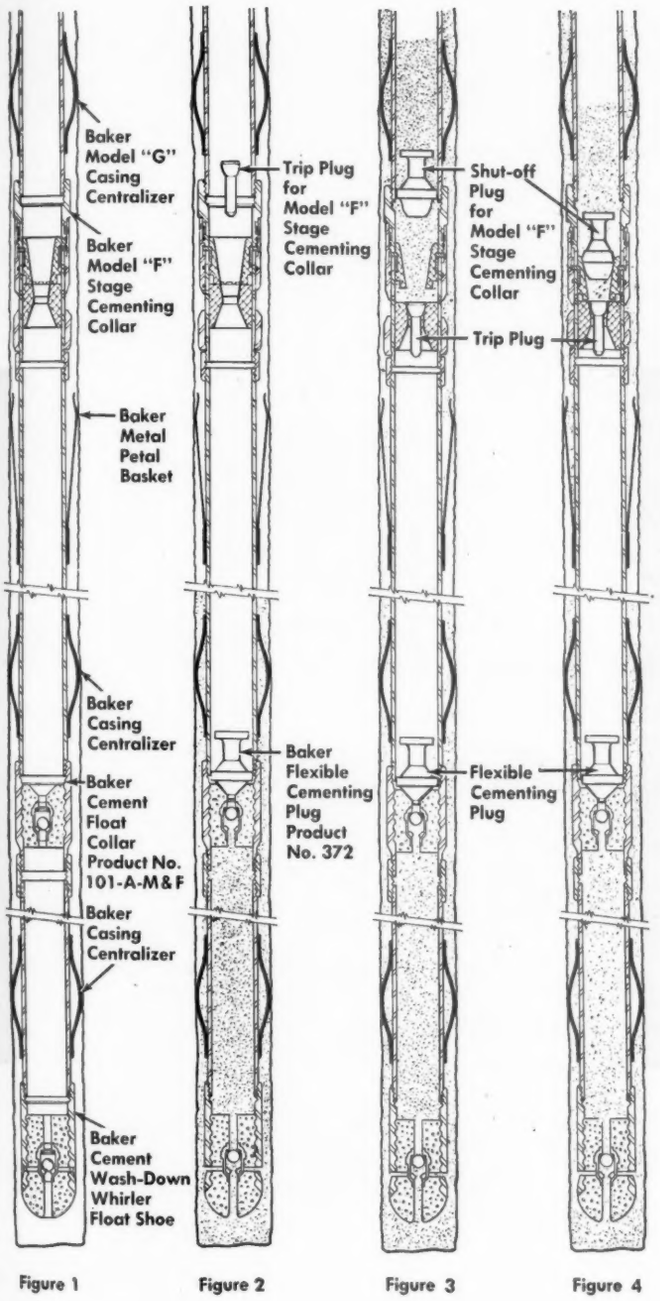
Baker Model "G" Casing Centralizer
Baker Model "F" Stage Cementing Collar
Baker Metal Petal Basket
Baker Casing Centralizer
Baker Cement Float Collar Product No. 101-A-M&F
Baker Casing Centralizer
Baker Cement Wash-Down Whirler Float Shoe
Trip Plug for Model "F" Stage Cementing Collar
Baker Flexible Cementing Plug Product No. 372
Shut-off Plug for Model "F" Stage Cementing Collar
Trip Plug
Flexible Cementing Plug

Figure 1 Figure 2 Figure 3 Figure 4

Ask any Baker representative or office for recommendations to make your stage cementing operations successful, "first-time" accomplishments.

BAKER OIL TOOLS, INC.

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Fig. 1—Hook-Up in Running-In and Mud-Conditioning Position. The string (starting at bottom) consists of a Baker Cement Wash-Down Whirler Float Shoe for conditioning the hole, washing away bridges, and cementation of the lower (first) stage. Baker Casing Centralizers are positioned at strategic points (as illustrated) to center the casing, ensure annular clearance, and avoid channeling of the cement slurry. Next above is a Baker Cement Float Collar with Seat for Flexible Plug, Product No. 101-A M.& F. A Baker Metal Petal Basket (optional equipment) is positioned just below the Stage Cementing Collar to retain all cement slurry *above* the Basket when the second-stage cementation is performed. Note that Baker Casing Centralizers are used just above the Stage Cementing Collar to ensure annular clearance for the upward movement of the cement slurry.

Fig. 2—The first-stage cement job has been completed. The Flexible Plug has been pumped through the Stage Collar to its seat in the bevelled top of the Float Collar where it prevents over-pumping and also separates the cement slurry from the follow-up fluid. The Trip Plug has been placed in the casing and is gravitating to its seat in the Lower Inner Sleeve of the Stage Collar; see also Fig. B on opposite page. Application of hydraulic pressure, after the Trip Plug is seated, will result in opening of the cementing ports.

Fig. 3—The second-stage cement job is almost completed. The cement slurry has passed through the open ports, and the Shut-Off Plug (acting as a separator) is approaching its seat in the Upper Inner Sleeve of the Stage Collar. Note how the Baker Metal Petal Basket has prevented downward movement of the cement.

Fig. 4—Both stages have now been successfully cemented. The cementing ports are closed off by the Shut-Off Sleeve which is locked in position as shown in Fig. C on opposite page. When the cement has set, the readily drillable internal mechanism of the Baker Stage Cementing Collar, Float Collar and Float Shoe are removed by the drilling bit leaving the full I.D. of the casing free from any sharp shoulders or other obstructions, ready for all subsequent operations.

USE BAKER STAGE CEMENTING COLLARS

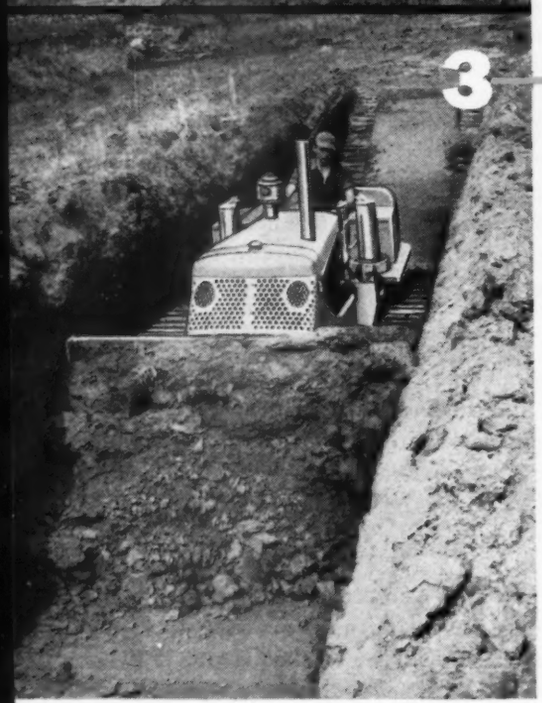
HERE'S *New Speed* IN SLUSH PIT DIGGING WITH ALLIS-CHALMERS HD-9 TRACTOR AND 9X NO PUSH-BEAM DOZER

1 Starting the cut.

Blade is mounted directly to HD-9 tractor main frame. This provides a steeper penetration angle and with tractor-dozer lowered as a single unit there's real down pressure to bite into hard material. With extra clearance, greatly increased track oscillation and better balance, this team is a phenomenal performer in mud and tough going.

2 Down she goes—fast.

Note how steep blade angle reduces length of ramp—saves time, cuts waste of long approaches. It gets down to a 6-ft. depth with only an 8-ft. approach, 11-ft. exit. And blade is 1,150 lb. lighter than standard dozer. Costs less to use.



3 Deep, narrow blade, powerful tractor hurries the job.

With blade six inches higher than standard model, it handles a bigger vertical load. This, plus narrow width, makes it ideal for digging deep, narrow slush pit. And the HD-9 Tractor with powerful 2-cycle diesel engine and long, wide tread tracks, provides power and traction for fast yardage.

4 And here's your pit—finished in the shortest possible time.

Just by pulling a single lever, operator can shift from any of the six forward speeds to any of the three reverses. And by using the high speed reverse he can back up in a hurry—reduce waste time to a minimum.

Get all the facts on this HD-9 Tractor, no push-beam dozer combination. Your Allis-Chalmers dealer can tell you why it's a versatile performer for general oil field use and a "yards ahead" dirt mover in slush pit digging.

8-ft. Highway Width Blade—no Transport Permit Needed.

You can transport this outfit from job to job at a moment's notice—without a special permit.

- 72 Drawbar hp.
- Weight with dozer, 21,500 lb.
- 6 speeds forward, 3 reverse

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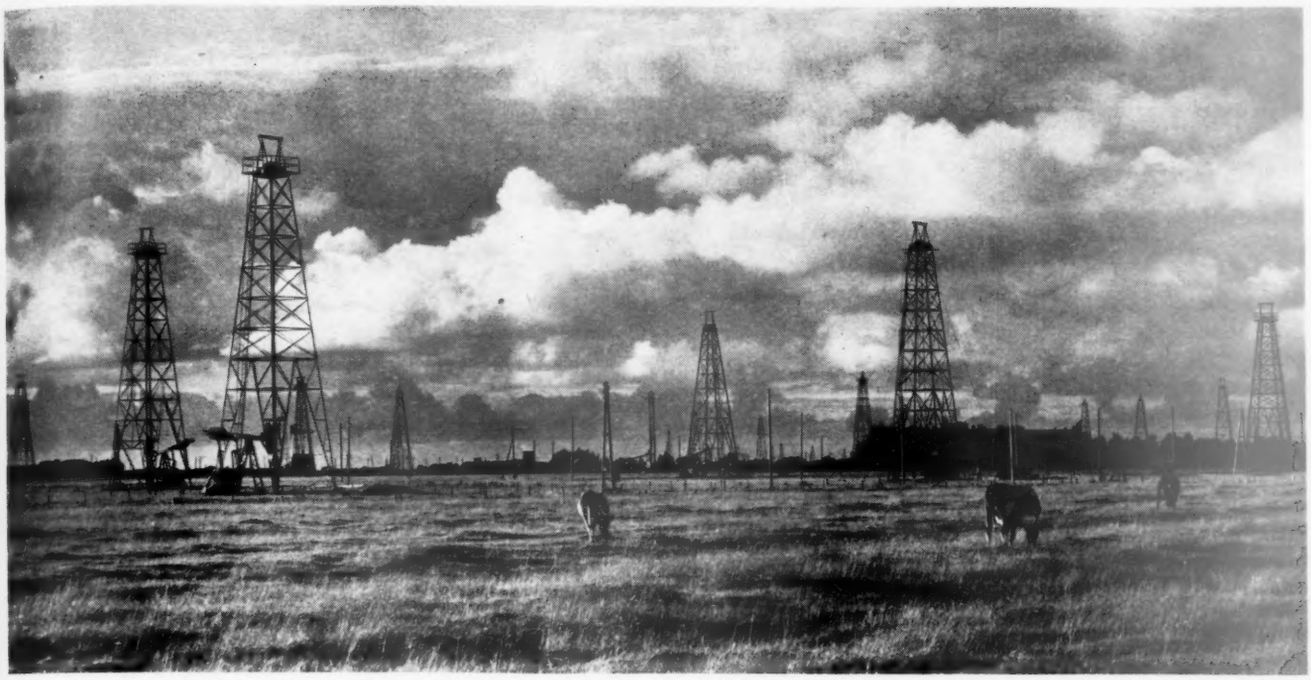


Heide oil field.

Increasing Oil Activities in Germany

Annual production may reach 20,000,000-bbl mark in next few years and wildcatting continues with high expectations.

ALFRED M. STAHMER

Crude oil production in Western Germany, which in former years was insignificant when compared with international standards, is on a steady upgrade. At a total crude oil output of 12,288,000 bbl in the last year, the country has surpassed the production rate of the Bahrein Islands and holds a leading position among the other oil-producing European countries outside the Iron Curtain, such as the Netherlands, France, Great Britain, and Italy. The 1952 production of the Austrian oil fields northeast of Vienna may reach 25,000,000 bbl — but they are under Soviet control due to the fact that the Austrian peace treaty has not yet been concluded and the Russian troops have not yet left the country.

In 1945, the year of the German capitulation, crude oil output was as low as 3,800,000 bbl, and no more than 255,000 ft were drilled.

Since then, production has more than trebled and drilling activities, with the help of 159 rigs, 105 being deep drilling units, were stepped up to the remarkable total of 1,325,000 ft drilled in 1951 and to 1,553,500 ft drilled during 1952.

In the first post-war years several critics were of the opinion that, considering the relatively high costs of drilling and field operations and the small average yield of each well (as compared to the Near East or Venezuela), German crude production was uneconomic and should better be abandoned altogether or confined to operations in some larger fields. The operating companies did not accept this point of view and, as a matter of fact, the development during the last years, i.e. the discovery of several prosperous accumulations, justified their optimism. Admittedly, the price of the crude at an average of $5.80 per barrel is relatively high and needs a protective duty. But on the other hand there is reason to hope that with rising production and the application of improved equipment and modern recovery methods it will in future be possible to reduce production costs. Furthermore, a considerable amount of dollars and other foreign currency is saved, employment rose and finally the country has certain securities against oil shortage in the world market that might arise from further trouble in the Near East.

EXCLUSIVE

The history of the German search for oil is marked by several milestones. The first was the discovery of the old Hanoverian fields Wietze, Eddesse, and Nienhagen in the 1870's and 1880's. Then, after decades, new finds were made in the 1930's at Moelme, Steimbke, Eicklingen, Fuhrberg, etc in Hanover, at Heide in the Schleswig-Holstein province, and at Reitbrook near Hamburg as the result of increased state-sponsored research. Another milestone was the discovery of oil in the Emsland border district during the last years of the war, where productive fields such as Emlichheim, Georgsdorf, Lingen-Dalum, and, later in 1949, Ruehlermoor, Ruehlertwist and Scheerhorn were found. In 1949 and 1951 a new impetus was given by the exploration of prosperous oil horizons on deep intermediate structures in areas between the classic salt domes of Hanover. The three fields, which have hitherto been discovered on that type of

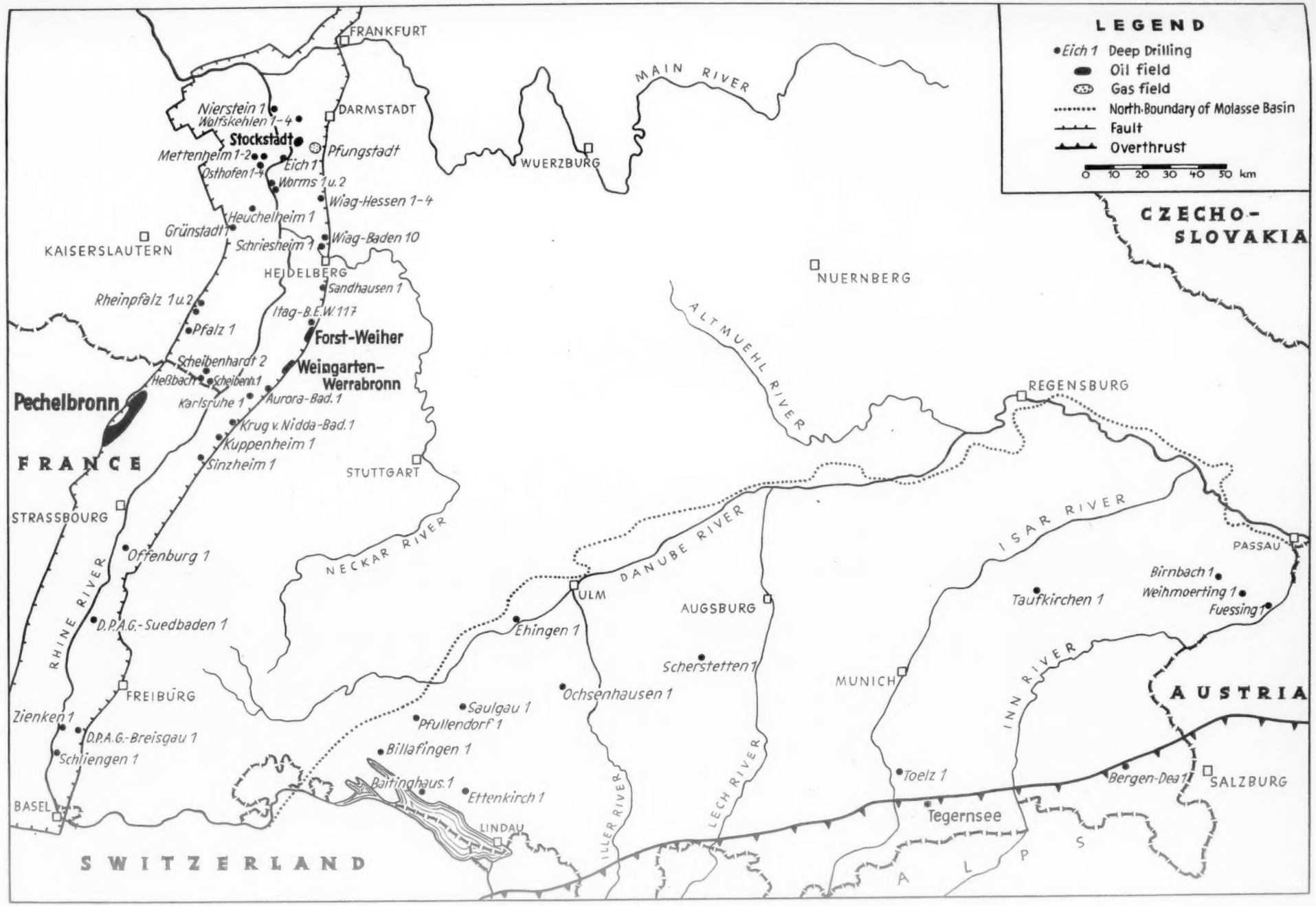
Map of Northwest Germany showing some oil and gas fields; also some salt structures and anticlinal trends.

structure, i.e. Suderbruch, Eldingen, and Hohne, have now assumed the first place among the Hanover oil fields. Suderbruch yields about 100,000 bbl of crude monthly. Here, except the main pay, the Cornbrash limestone of the Middle Jurassic, oolitic limestones, and sandstones of the Upper Jurassic (Gigas beds) and the Valendis sandstone of the Lower Cretaceous are being exploited. Recently, oil was also found in a shale formation. Hohne and Eldingen, producing from some horizons of the Jurassic and Triassic, each yield about 65,000 bbl a month.

Not only here, but also in three other areas of Western Germany, outside the main producing provinces of the Emsland and Hanover, some outstanding drilling results have been achieved recently, that may give the start for a promising development in the future.

Schleswig-Holstein

Until a few months ago only two fields were known north of the Elbe River, i.e. Heide and Reitbrook. Some former wildcatting in Central and Eastern Holstein brought no encouraging results. Hitherto, Heide had been producing from the



Map of Southern Germany showing Baden oil fields and well locations.

top of the Heide salt structure. In 1951 Deutsche Erdoel-AG began drilling exploration wells in order to test the deep western flank of the structure. One of the wildcats, which later proved to be dry, was situated outside the North Sea Dyke, several miles away from the coast line. It was the first off-shore well in Germany. At about the same time the Danish-American Prospecting Company, an affiliate of Gulf Oil, commenced drilling operations farther to the north in Denmark near the German border. The first well, Tonder 1, found good gas traces but was later abandoned as unsuccessful. In late January 1952, the endeavors of Deutsche Erdoel-AG resulted in the find of Hohenwoehrden. The well Hohenwoehrden 2a, for the first time in Schleswig-Holstein, tested a section of oil impregnated sands and sandstones of the Wealden (Cretaceous) and Dogger (Jurassic) age.

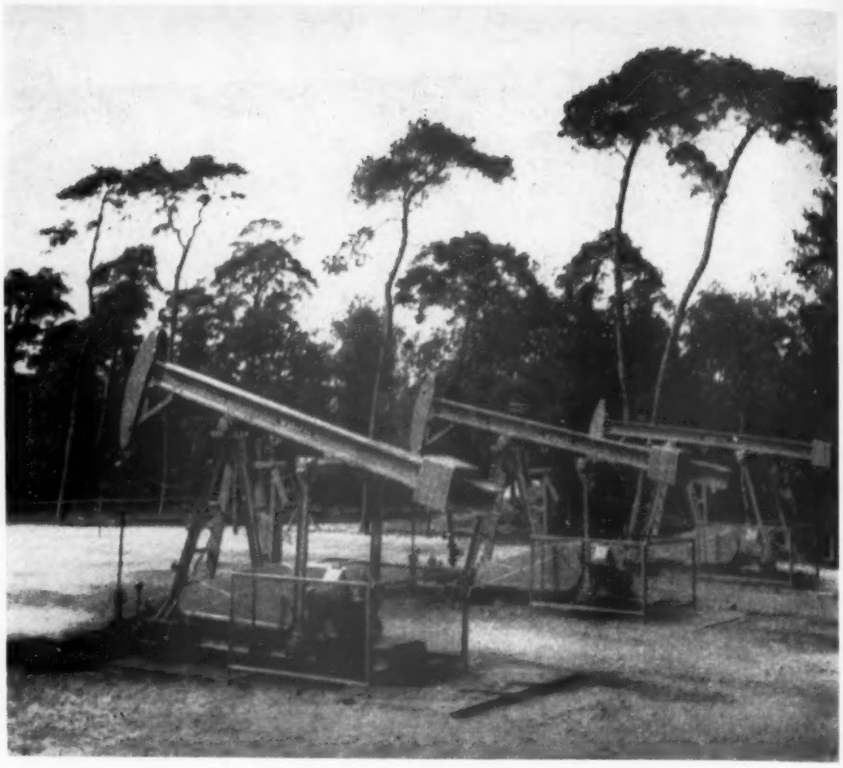
Although this could perhaps be regarded as an extension of the old Heide field, the discovery of Boostedt in Middle Holstein by Deutsche Vacuum Oel AG (Socony-Vacuum) on a joint concession of Vacuum, Deutsche Erdoel-AG, and Preussag, at the end of May 1952 was striking news. The successful well Boostedt 1 is situated at the eastern flank of an elongated salt upthrust that borders upon the "Hamburger Loch", a deep sedimentary basin. The pay in Boostedt is a Dogger sand at a depth of 5650 ft. In October 1952 the well flowed about 7000 bbl of a light crude (SG 0.870). In November 1952, Deutsche Erdoel-AG was able to report a second find on the same salt structure, about 8 miles north of Boostedt. The wildcat well Ploen 2 came in with a yield from the Dogger about as good as that of Boostedt 1. The light crude of Ploen 2 (SG 0.860) is produced from a depth of 6480 ft.

Several other companies have already located wildcats in other parts of the province. Doubtless the search for oil will be increased in Schleswig-Holstein in future months.

Weser-Ems Area

In 1950 oil was found on a joint concession of Gewerkschaft Brigitta (Shell, Standard of New Jersey) and Vacuum at Quakenbrueck in South Oldenburg. Early expectations that here, half-way between the producing districts of the Emsland and Hanover, a new oil area could be developed were disappointing when it turned out that the heavy oil of Quakenbrueck had a very high pour point so that the tubing had partly to be electrically heated to achieve a yield at all. But at the end of 1951, the wildcat Hemmelte-West 1, situated on a faulted anticline northwest of Quakenbrueck, came in with good production from the Upper Jurassic at a depth of 3970-4070 ft, the crude is much lighter than that of Quakenbrueck (SG 0.864). In the meantime about a dozen more wells have found oil in Hemmelte-West. In October 1952, the output of the field amounted to 27,000 bbl.

Two recent finds confirmed that good oil and gas possibilities indeed exist between the Dutch border and the river Weser. In August 1952 Wintershall AG was successful in its wildcat Rehden 5, 15 miles east of Quakenbrueck, with a natural gas deposit in the main Dolomite of the Zechstein. A daily flow of almost 3,200,000 cu ft of gas through a 16/64-in. choke was measured. In November 1952, some miles north of Rehden near the village Aldorf, Wintershall AG penetrated oil-bearing Dogger sands in its exploration well Dueste 7. Production tests at a depth of 3651-3665 ft were successful. The well pumps approximately 70 bbl daily. Meanwhile oil traces were also found in exploration wells northwest and northeast of Hemmelte, the final results of which are not known yet.



Multiple pumper in the Ruehlertwist oil field, Emsland province.

New Oil Field on the Upper Rhine

For about 200 years crude oil has been extracted near Pechelbronn in Alsace (France). Formerly oil production at Pechelbronn was a primitive enterprise. About 35 years ago shafts were sunk to produce oil by mining. In the 1930's, on the German side of the Rhine Valley graben, two small deposits, Forst-Weiher and Weingarten, were discovered. They are situated on tilted fault blocks at the eastern border of the graben zone. At the moment these two fields together yield little more than 3000 bbl of crude per month. After 16 years of unsuccessful wildcatting, interrupted by periods in which no research work at all was done, in August 1951 a gas blow-out occurred in the Wolfskehlen 1 well of Gewerkschaft Elwerath, which was surprising because at a depth of 3000 ft in the hydrobia beds no gas or oil was expected. In September 1952, a second gas eruption took place in a well at Eich, on the left bank of the Rhine River, and in November Deutsche Erdoel-AG penetrated the gas-bearing hydrobia beds in its Pfungstadt 2 well, at a depth of 2300 to 3260 ft. There is reason to assume that it will be possible to develop commercial gas production at Pfungstadt.

While writing this report, good news was received on the wildcat well, Stockstadt 1 of Gewerkschaft Elwerath, situated some miles south of Wolfskehlen. At a depth of 5250 ft oil has been found at Stockstadt in the Pechelbronn beds of the Lower Oligocene. The crude is light (SG 0.825-0.830) but it has a very high paraffin content and a surprisingly high pour point (+20 C). This is the first time that Pechelbronn beds were met in the northern part of the Rhine Valley graben. Furthermore, it has now been confirmed that oil can be found not only at the borders but also in the center of the graben zone. During preliminary production tests the hole flowed 145 bbl daily through a 5/64-in. choke and 380 bbl through a 8/64-in. choke.

The Amt fuer Bodenforschung (German Geological Survey) has published an estimate of the underground reserves according to which 210,000,000 bbl of proved and 95,000,000 bbl of probable reserves existed on January 1, 1952. The new discoveries in 1952 may add some further million barrels. It does not appear to be too optimistic to forecast that West Germany will surpass the 20,000,000 bbl mark of annual production in the course of the next few years. Taking into account the steadily rising home demand for mineral oil it can be assumed that the indigenous crude oil, covering at present about 33 per cent of the West German oil demand, will maintain this share in the future. * * *

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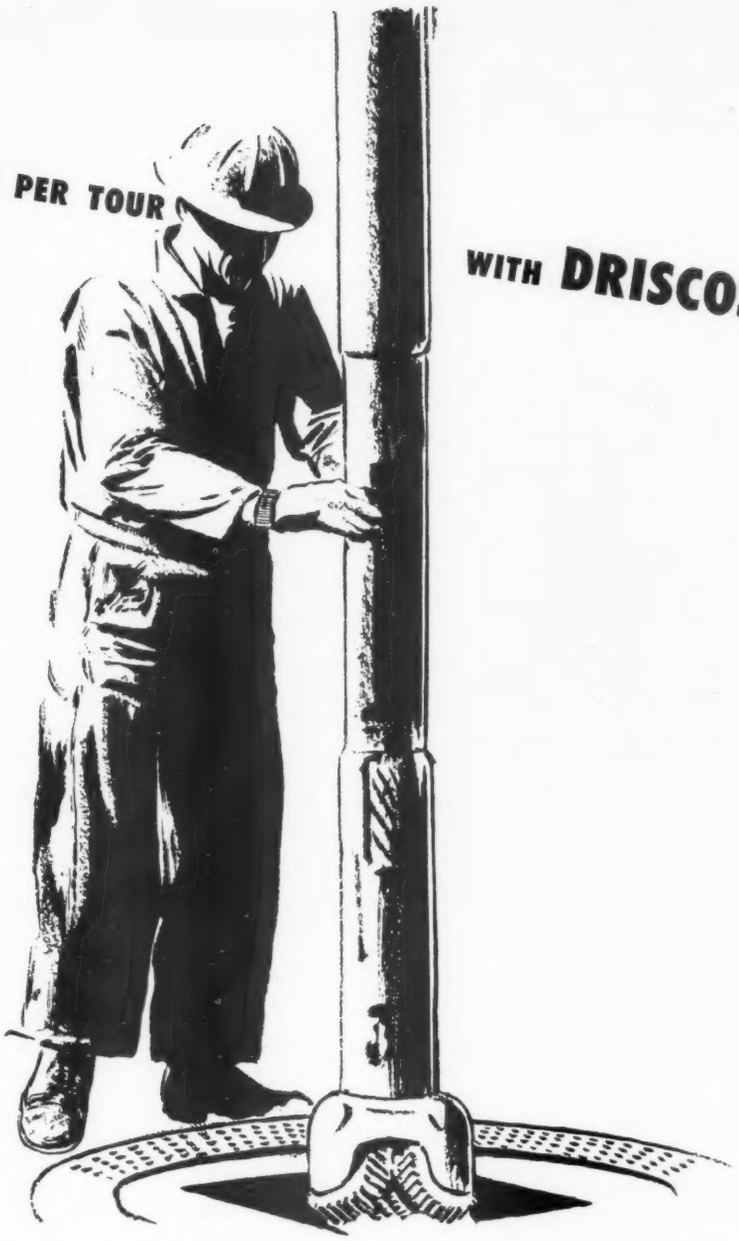

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Prospects for Improving Oil Recovery†

Certain field operations are showing signs of promise with new methods designed to increase the ultimate production

PAUL D. TORREY*

A CONSIDERATION of the factors that control the movement of fluids through the openings of oil reservoirs indicates that most of them are not susceptible to alteration that would serve to benefit oil recovery or would accelerate the rate of oil recovery. This statement, of course, is subject at once to some qualification for it is possible to alter to some extent the radius of well bores by various mechanical processes or to reduce the radius of the drainage area by the drilling of additional wells. Such changes, however, may be made in many cases only with some difficulty and, very likely, at considerable expense. Consequently, they may not be at all practical or economical. Obviously, geometric and logarithmic functions, as well as the thickness of the oil-bearing rock are not subject to change, and long experience has shown that there is a very definite limitation to the differential in pressure that may be created in the reservoir. Thus, it will be evident that reduction in reservoir crude viscosity or increase in the permeability of the reservoir rock to oil or to water, whichever may be desired, appear to be the most promising possibilities for improving the efficiency of oil recovery. Several methods have been proposed whereby reservoir crude viscosity can be decreased and effective permeability can be increased. Some of these methods, which seem to have promising economic possibilities are considered in this paper.

Reservoir crude viscosity can be reduced by the application of heat, by dilution with light hydrocarbon liquids, and by the solution of light hydrocarbon gases. Increase in effective permeability to oil or to water may be effected by increasing the preferential wettability of the reservoir surface to the respective liquid phases. An increase in permeability to water may also take place by a reduction in the interfacial tension between oil and water, which, in turn, tends to reduce the capillary pressure existing in the more minute pore passages.

Pyrovolatilization

Pyrovolatilization is a process of underground vaporization, proposed recently by Slezak and Davis[1] for application in the Bradford field, in which the reservoir is first fractured by high voltage electricity and its temperature then increased to the point where the oil in the porous rock immediately surrounding an input well will ignite spontaneously when compressed air is injected into it. It is conjectured, quite reasonably, that the water occurring in the reservoir will be converted to steam, and that recovery of oil will be obtained as a result of a steam distillation process. As the process is continued, it is believed that vaporization of both oil and water can be controlled by maintaining back pressure at the producing wells. The total pressure that can be developed in the reservoir will be fixed by the vapor pressures of water and oil at any specified temperature. Thus, the pressure will decline from the higher to the lower temperature zones. It is proposed to raise the temperature of the Bradford sand initially to an average value of 400 F by means of electricity, and thereafter by the burning of some of the oil in the reservoir. The vapor pressures of oil and water at this temperature are about 100 psi and 250 psi respectively, so it will be necessary to inject compressed air into the sand at a somewhat higher pressure.

The authors[1] estimate that about one-third of the oil in the reservoir will be consumed to provide the necessary heat.

The movement of fluids through the Bradford sand at the vapor pressures created by an increase in temperature to 400 F will be quite slow on account of its low average permeability. Consequently, it would seem that there should be greater opportunities for the economic application of the process of pyrovolatilization to other of the much more shallow and much more permeable reservoirs of western Pennsylvania. Many of the shallow Venango sand reservoirs have responded successfully to pressure differentials in the range of 100 to 250 psi in artificial gas drive.

Application of Hot Gases

In 1927, A. F. Melcher, research physicist with Marland Oil Company (now Continental Oil Company) attempted to increase oil recovery by heating a very shallow oil sand, which was found at a depth of around 20 ft, with hot exhaust gases produced from the cracking stills of the nearby Ponca City refinery. Large diameter holes were drilled for the injection of the hot gas in order that a person could be lowered to the level of the oil sand, after the hole had been cooled, to inspect the effects of the application of heat. It is recalled that temperatures of around 700 F were applied to the reservoir, and in a matter of a very few months no more hot gas could be injected, but during this period some increase in oil recovery was noted in four offset producing wells situated in a square pattern 50 ft away from the input well. Subsequent inspection of the oil sand in the input well revealed that the pores had been plugged by the deposition of carbon and asphaltic material, and possibly by some fusion of soft clay element.

Subsequently, Russian authors[2] have reported on experiments conducted in the Grozny field where hot exhaust gases were produced at the bottom of wells by the burning of natural gas under pressure when mixed with the correct proportion of air. Moderate increases in oil production were reported, but the performance of the wells, as described by the authors, certainly indicates plugging of the sand, presumably from the deposition of carbon and quite possibly from vitrification. Either of these phases would reduce greatly any temporary benefits that result from the application of heat energy to the reservoir by the injection of hot gas.

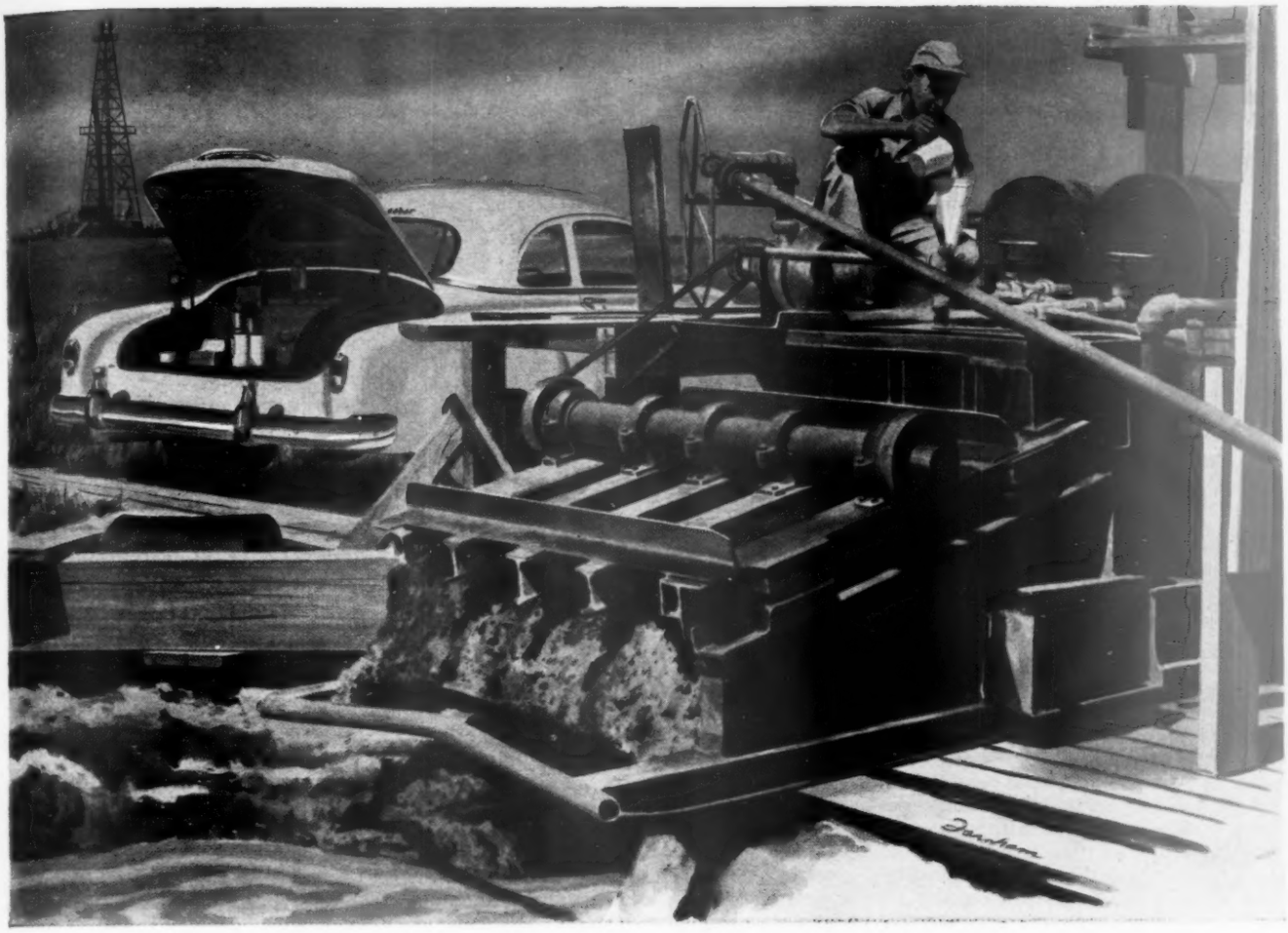
The results of these two field tests are similar although they were taken under widely different conditions and in widely separated areas. They point to a generalized conclusion that application of hot gases, at the high temperatures necessary to affect the entire volume of the reservoir, will rarely be practical because of the cracking of the oil and deposition of carbon, and because of the distinct possibility that vitrification of the reservoir will take place.

Application of Hot Water

Recently, Frederick Squires and Edmund S. Merriam[3] have described a submerged burner for the underground generation of heat, which avoids the application of excessively high temperatures to the face of the reservoir in an input well by the production of steam

†A resume of an extemporaneous paper presented to the Oklahoma Section of the Petroleum Branch of the American Institute of Mining and Metallurgical Engineers at Ponca City, Oklahoma, November 17, 1952.

*President, Orchem Corporation, Chairman, Secondary Recovery and Pressure Maintenance Advisory Committee, Interstate Oil Compact Commission, Special Lecturer in Petroleum Engineering, The University of Texas.



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right at the bottom of the well. The steam so produced will take on additional heat liberated by the burner. The resulting mixture of steam with the products of combustion will hold the heat generated by the burner largely as latent heat. Thus, heat losses in a vertical direction are minimized as most of the heat is carried into the formation as latent heat rather than as sensible heat.

The underground burner is submerged in water near the bottom of an input well. Fuel oil and air, or gas and air, are piped to it from the surface in the correct proportions and are ignited and burned. The hot exhaust gases are conducted below the surface of the water where they are released to generate steam. The mixture of exhaust gas and water vapor may have a temperature initially below the boiling point of water. It will deposit liquid water when its dew point is reached as it cools while passing through the reservoir. The condensing steam liberates its heat, but, of course, it does not do this all at one point. Some water vapor is retained in the mixture and is deposited only as the dew points are reached for mixtures carrying less and less steam with increasing distance from the input well.

The Squires-Merriam underground burner has been employed successfully in a small scale field trial, but in this test it is doubted whether it would have been commercially successful because of high cost of fuel. The principal problem, therefore, in the economic application of heat to increase oil recovery is to get sufficient heat into the reservoir at minor cost. A fascinating possible solution to this problem has been proposed by Frederick Squires,[4] based on his studies of the experimental underground coal gasification project of the Alabama Power Company and the United States Bureau of Mines, at Gorgas, Alabama, where 10,000,000 cu ft of exhaust gas, at a temperature of 1700 F, have been produced daily. In this operation it has been demonstrated that the volume of gas at the high temperature can be produced almost indefinitely. It has also been shown that the hot gas will move through permeable sandstones above the burning coal bed, and that it can be brought to the surface through open holes that have been drilled through them. It is immediately apparent that if this hot gas could be conducted to the bottom of input wells rather than brought to the surface, a problem that should be rather easily solved, the process of injecting a mixture of steam and exhaust gases, as proposed by Squires and Merriam,[3] could be applied much more economically, because hydrocarbon gases or liquids would not be required for the generation of heat. Squires and the writer have emphasized that many of the shallow oil-producing areas of the United States are situated where deposits of coal are in close proximity to the oil reservoirs. Many of the coal beds are so thin or are of such inferior quality that they cannot be produced profitably for above ground fuel supplies. Nevertheless, there is no reason why they could not be ignited and caused to produce hot exhaust gases, which could be used in oil recovery processes.

In somewhat similar manner, the heat developed in the generation of carbon dioxide for the Orco process could be used to increase the temperature of the carbonated water. Although heating of the water at the surface would not be as effective as underground heating, the loss from radiation as the warm water moves from the surface to the reservoir should not be too great at moderate temperatures.

Dilution by Light Hydrocarbon Liquids. Recalling the familiar technique in which samples of oil reservoir rocks are cleaned for various laboratory tests by solvent action, it could be expected that a high degree of recovery of oil might be obtained by the injection of light liquid hydrocarbons into oil reservoirs. Dilution of a heavy crude oil with light hydrocarbons will reduce viscosity in addition to the benefit that should be obtained from the scrubbing of the reservoir surface by a solvent. The solvent could be injected into the reservoir either in the form of a liquid or condensable gases.

At the Fourth Texas Petroleum Recovery Conference, H. T. Kennedy[5] proposed a method whereby substantial increase in oil recovery could be obtained in connection with the storage of liquified petroleum gases, commonly known as "LPG." It was pointed out in his paper that the seasonal nature of demand for LPG and the fact that it is frequently a byproduct of natural gasoline manufacture, often makes unusually large storage capacity necessary. Depleted gas-drive reservoirs represent one good possibility for storage purposes and at moderate depths, assuming that all wells are tight, or, if abandoned, are properly plugged, such reservoirs are adequate to withstand any required pressure. In order to obtain the benefit that can be expected from the injection of LPG, the oil reservoir must have fairly pronounced structural relief and high permeability in order to facilitate gravitational segregation of reservoir fluids. It is also essential that wells be completed at both high and low structural positions. The wells located at high structural position will be used for the injection of LPG. Wells located at low structural position will be used to produce diluted crude with lowered viscosity. Laboratory experiments have indicated the possibility for a higher recovery of oil by the injection of LPG at high structural position than is obtainable by any other recovery process. In actual practice the percentage recoveries indicated by laboratory work will probably not be obtained, but the writer[6] has described projects in California and in Iran, where substantial increases in oil recovery have been indicated by the dilution of fairly heavy crude oils by light hydrocarbon liquids.

The limiting factor to LPG injection by the Kennedy method is the necessity for pronounced structural relief in the reservoir. A dip of at least 10 from the axis of the structure is considered to be essential, and, theoretically, the efficiency of the recovery process increases in structures with more acute dips. The steeply dipping anticlines, which have controlled the accumulation of oil in many of the fields of California and Iran, obviously, are ideal for the LPG injection process.

Solution of Light Hydrocarbon Gases. Laboratory and field experiments have indicated that the injection of light hydrocarbon gases prior to water-flooding, and high pressure gas injection under certain specific conditions result in substantial increase in oil recovery over the amount that could be obtained by unaided primary recovery from gas-drive reservoirs.

Injection of Natural Gas

As reported independently by Schiffman and Breston,[7] and by Holmgren and Morse,[8] an increase in gas saturation in the reservoir rock prior to the injection of water in laboratory tests has resulted in an increase in oil recovery of up to 50 per cent above that which would have been obtained by the use of water alone. It is believed that the beneficial results observed in laboratory experiments of gas injection prior to water flooding are due to several factors among which can be cited:

a. An increase in mobility brought about by changes in relative permeability values, and by a reduction in the viscosity of the reservoir crude oil.

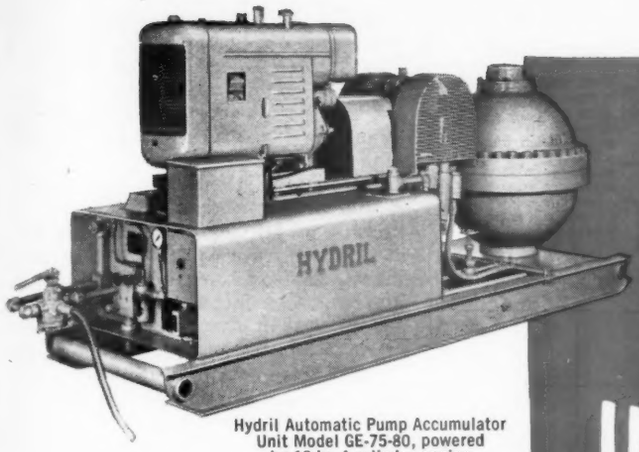
b. Increased formation volume factor resulting from the swelling of the reservoir crude oil by solution of gas.

c. Increase in temperature by release of latent heat of vaporization as gas is dissolved in crude oil.

d. Selective filling of the more permeable sections of the reservoir with gas bubbles (the Jamin effect) ahead of the water, thus reducing the tendency of the water to bypass through zones of higher permeability.

As reported by the writer,[9] field experiments over a period of several years by the South Penn Oil Company in the Bradford field have tended to confirm the results of the laboratory work even though the prior injection of gas was employed originally as a fuel conservation measure. Fairly limited experience, however, with gas injection prior to water-flooding in shallow Oklahoma fields producing from the Bartlesville sand has been quite negative. Little or no increase in oil recovery, above the amount that could be expected from conventional water flooding, has resulted from prior injection of gas.

In 1944 Frederick Squires[10] first proposed secondary recovery by simultaneous injection of gas in the central part of a field possessing low structural relief, and the injection of water around the edge. He proposed, also, an ideal method of pressure maintenance for fields situated on well defined anticlinal structure in which gas is injected in wells situated at the highest part of the structure and water is injected contemporaneously slightly below or at the existing water-oil contact. The method proposed by Squires first received a field test, as far as is known, in the West Tepetate field, Louisiana, by the Barnsdall Oil Company (now Sunray Oil Corporation) where water injection was commenced in 1946 and gas injection



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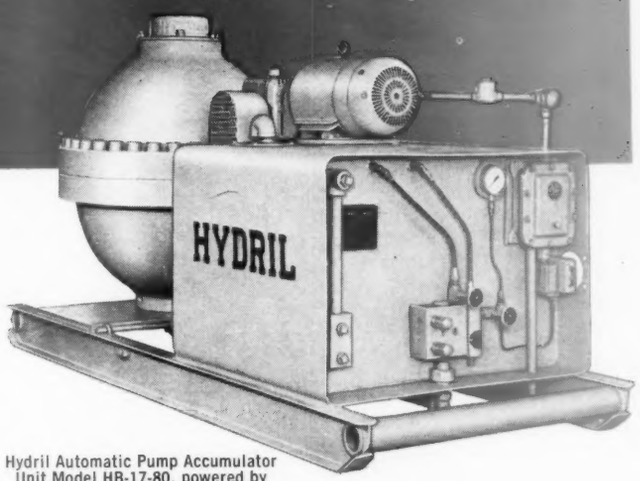

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was commenced in 1947. Results of significant importance have been obtained from this project, and it is indicated to be one of the most effective pressure maintenance projects in the United States.

High Pressure Gas Injection Method

As reported originally by Wharton and Kieschnick,[11] and subsequently discussed by Griffith and Hollrah,[12] it has been shown in both laboratory and field experiments that the injection of gas into oil reservoirs at pressures much higher than those used in most conventional gas pressure maintenance projects will result in considerably improved recovery of oil. In addition to employment of injection pressures in excess of 3000 psi, it is indicated that recovery is improved by the injection of an appreciable quantity of intermediate boiling range hydrocarbons, and by an undersaturation of the reservoir oil at the pressure of displacement. Improved recovery by the high pressure gas injection process is believed to be obtained as a result of:

a. Reduction in reservoir crude oil viscosity.

b. Swelling of reservoir crude oil to give a high formation volume factor.

c. Evaporation and solution effects which reduce the final residual oil saturation.

Increase in the formation volume factor, unquestionably, is one of the most important and promising features of the high pressure gas injection process. By inducing a swelling of the crude oil to several times its original volume the continuity of the oil phase in the reservoir is maintained together with a high relative permeability to oil.

Unfortunately, there are many shallow oil reservoirs in the United States that will not withstand the pressures required for the successful application of the high pressure gas injection process. Also, in many of the shallow producing areas there are only limited quantities of LPG available. Consequently, recent studies conducted by Montclair Research Corporation for Oil Recovery Corporation on the effect of carbon dioxide on the solubility of natural gas hydrocarbons in crude oil are significant.

Although an appreciable amount of data are available on the solubility of natural gas in various crude oils at elevated pressures, up to the present little information has been available on the effect that carbon dioxide has on the solubility of methane, ethane, and other gaseous hydrocarbons in crude oil. Data developed by Montclair on the solubility of carbon dioxide, methane and ethane in Pennsylvania Grade crude oil at 80 F are shown in the accompanying illustration, Fig. 1. In this figure the total solubilities of mixtures of carbon dioxide and ethane or methane in Penn Grade crude oil at the final equilibrium pressure are shown by Curves 2 and 4. For the carbon dioxide-ethane mixture of 1.50:1.00 partial pressure ratio (Curve 2) the 900 psi pressure point corresponds to a carbon dioxide partial pressure of 540 psi and a methane partial pressure of 360 psi.

From the accompanying figure it will

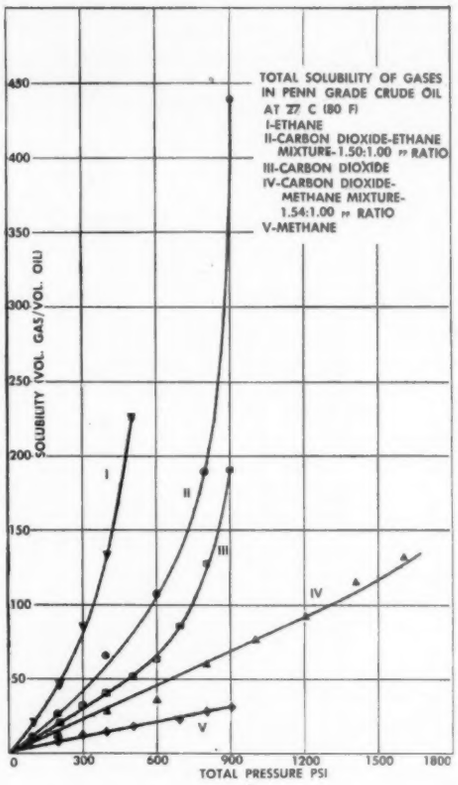


FIG. 2

be seen that the solubility of methane is practically a straight line function over the pressure range examined. The carbon dioxide data are interesting in that while the solubility increases gradually over the range of from 100 to 500 psi in a straight line fashion, a rather sharp increase in the slope of the solubility curve occurs at the 600-700 psi pressure point. Above this inflection point the solubility of carbon dioxide increases rapidly with increasing pressure. The solubility of ethane increases rapidly with increasing pressure with the result that at a pressure of 500 psi the solubility is as much as 232 volumes of ethane for one volume of the crude oil.

From these curves it will be apparent that the use of carbon dioxide to increase the solubility of gaseous hydrocarbons in crude oil has important possibilities in various oil recovery processes. It is believed to be true generally that formation volume factors of reservoir crude oils are directly proportional to the volume of gas dissolved. In contrast, as shown in the solubility curves, at a pressure of 900 psi, where the solubility of methane in the crude is only 30 volumes per volume of oil, the solubility of the CO_2-CH_4 mixture at a partial pressure ratio of 1.54:1.00 is 70 volumes per volume of oil. The total solubility of the CO_2-C_2H_6 mixture at approximately the same partial pressure approaches the exceedingly high value of 440 volumes per volume of oil. This phenomenon should be of particular interest both in primary and secondary production operations. The addition of carbon dioxide would increase the solubility of the hydrocarbon gases so that their release from solution would be greatly retarded as the pressure in the reservoir is reduced.

In this connection, it should be noted that the application of carbonated water† to oil reservoir rocks invariably has resulted in the production of mixtures of carbon dioxide and abnormal quantities of hydrocarbon gases heavier than methane. Thus, the produced gas from an application of the Orco Process should prove to be an ideal mixture to promise a high degree of reservoir fluid swelling. Once a cycle of use is established, the combined effects of carbon dioxide, when mixed with hydrocarbon gases and then dissolved in the reservoir crude in advance of the injection of carbonated water—a preconditioning process—and as it is employed in the Orco Process could prove to be a remarkably effective technique for improvement of oil recovery.

Although the data presented are based only on tests in which Pennsylvania crude oil has been used, possible application to crude oils possessing much higher viscosity is apparent. If for instance, at a pressure of less than 1000 psi, it is possible to bring about a solution of around 500 volumes of a CO_2-C_2H_6 mixture in one volume of crude oil, equivalent to around 2800 cu ft of the mixture in 1 barrel of stock-tank crude, this amount of gas in solution could be expected to double approximately the volume of the crude as it may have existed in a reservoir depleted of its original natural pressure. In addition, the solution of this amount of gas could be expected to decrease the viscosity of the oil to less than 10 per cent of the viscosity of the dead crude oil. It is indicated, therefore, that by mixing carbon dioxide with light hydrocarbon gases the same effects can be produced at from a quarter to a third of the pressure required for the high pressure gas injection process, and without the need for appreciable quantities of intermediate boiling range hydrocarbons.

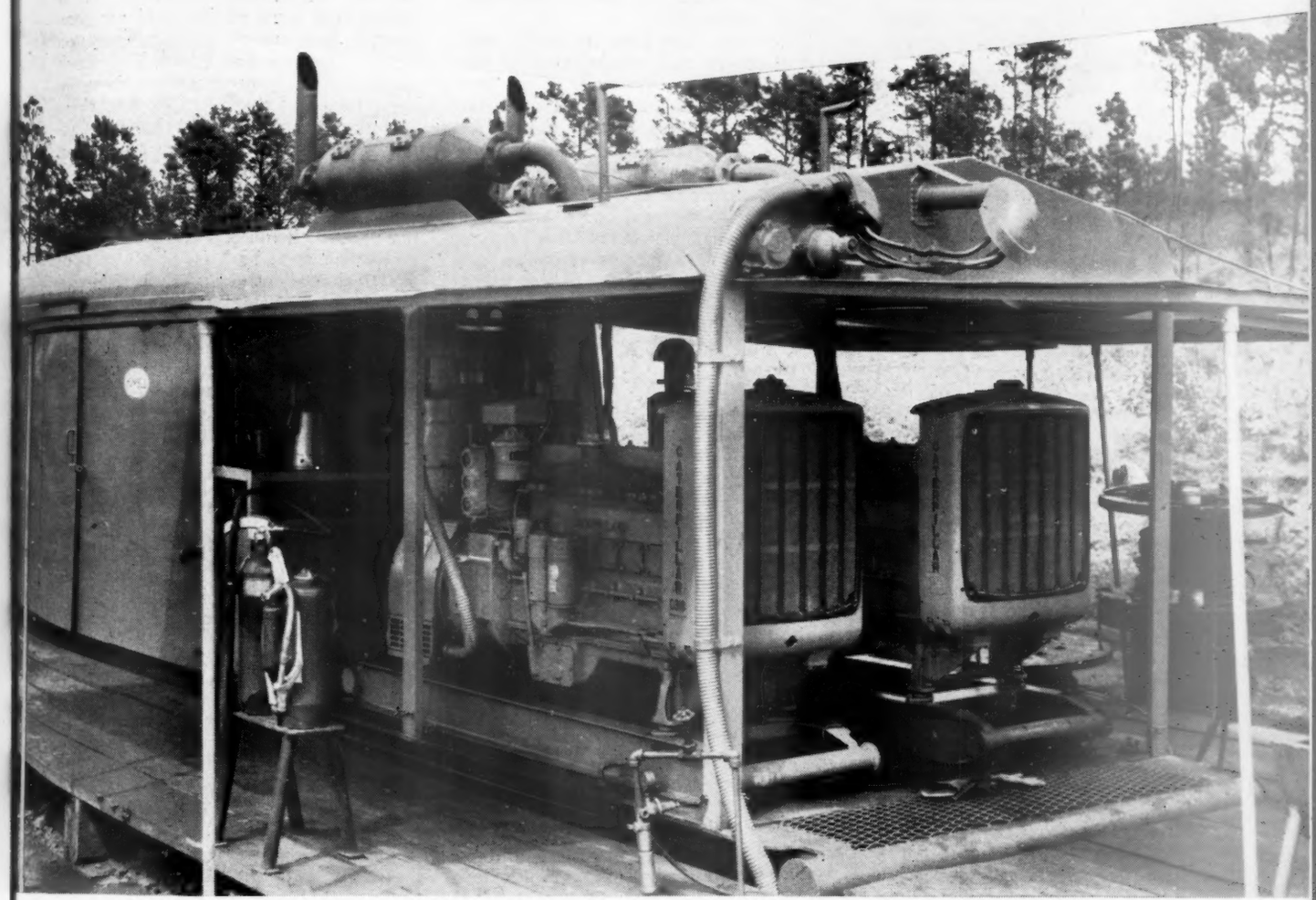
Recovery Processes

Techniques and methods that have been discussed or proposed in preceding sections of this paper will serve to increase the efficiency of oil recovery processes because they will improve the mobility ratio. Other methods for improving oil recovery that have been receiving a great deal of attention in the last few years have been directed to a reduction in capillary pressure in the more minute pore openings of reservoir rocks by a reduction of interfacial tension between the liquid phase, and to an alteration tension between the liquid phases and the solid, thus affecting the preferential wettability of the solid surface to either oil or water. The two chemical methods, which have been applied recently with encouraging and in some instances quite positive results are the Orco Process and the special application* of various surface active chemicals. The details of these methods and some of the results that have been obtained by their application have been

†The Orco Process.

*Orchem Corporation combinations with Armour surface active chemicals.

CAT Electric Sets make good at Cusseta Wildcat



On the Cusseta Wildcat, in Cass County, Texas, a major oil company has been using Caterpillar Diesel Electric Sets for electric power around the rig.

A pair of Cat D318s, shown above in the dog house, generate power to drive two mud stirrers, mud mixer, two water pumps, steamer, shale shaker, blowout preventer, compressor, air compressor blower, lights and dynamatic brake. Each unit has a rated output of 60 KW, and they can be run alternately or both at once, as loads require.

Mr. E. D. Wolcott, the driller, reports: "These electric sets are holding up fine. They give no trouble at all, and handle loads and load changes without special attention."

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discussed adequately by James W. Martin,[13,14] and by the writer[15] and his colleagues[16] and need not be repeated. There is, however, some additional information that is not contained in these papers that is deserving of brief review.

The Orco Process

Expansion of application of the Orco Process was curtailed seriously by an unfavorable report from the laboratory of the Pennsylvania Grade Crude Oil Association, which was presented at the Fifteenth Technical Conference on Petroleum Production at State College, Pennsylvania, October, 1951. The negative results reported in this paper were based on tests performed on only three sand samples. One of the samples was obtained from an outcrop of a sandstone that contained no natural oil saturation; the other two were from the Venango sand series that have not responded successfully to water-flooding. To those who were familiar with the specialized techniques required for laboratory oil recovery tests with carbon dioxide, the results obtained by the Penn Grade Association were not surprising, particularly as by no means all oil recovery tests with carbonated water are uniformly successful. Nevertheless, the unfavorable publicity that resulted from the publication of the laboratory work of Penn Grade Association had a very discouraging influence on plans for field applications of the Orco Process that were receiving active consideration at that time.

Subsequently, in a forthright reversal of its previous findings, the production research laboratory of the Pennsylvania Grade Crude Oil Association at the Sixteenth Technical Conference on Petroleum Production, at State College, Pennsylvania, October 22-24, 1952, reported that much more extensive and properly conducted laboratory tests indicated that the use of carbon dioxide solutions in water flooding would yield a higher recovery of oil than plain water alone. The results of the more recent tests were so favorable that a large scale field test has been recommended by the Penn Grade Association laboratory.

Much of the criticism that has been directed to the Orco Process seems to be based on a lack of complete understanding of the mechanism of the process, which Martin[14] and the writer[15] have admitted repeatedly. The fact that the nature of the reaction between carbon dioxide and hydrocarbon compounds, whether it be physical or chemical, is not known completely is not astonishing. Each year, under the influence of solar energy, plants synthesize their complex organic constituents from carbon dioxide as the only source of carbon, from water, and from inorganic salts derived from the soil. Although the phenomenon of photo-synthesis is the most important reaction in the life cycle of all living organisms, its exact nature remains unknown even though it has been the subject of intense scientific investigation. Nevertheles, it is a notable fact that even though farmers do not understand how carbon dioxide combines itself with water to form edible carbohydrates they are not detered from planting every year the wheat and other grain crops that are essential for the existence of the human race. When it is recognized that photosynthesis utilizes two of the most simple molecules, it should not be difficult to appreciate that the possible reaction between carbon dioxide and much more complex molecules of carbon and hydrogen may be much more complicated, and, correspondingly, much more difficult to determine.

Those who have been connected with the discovery and development of the Orco Process are conscious of the fact that it cannot be applied with equal measure of success in all fields. Also, that its application will be limited in some cases by economic factors as well as by unfavorable reservoir conditions. Nevertheless, the evidence available at this time indicates that the Orco Process has reached a stage of development that should enable it to play an important part in improving the efficiency and economy of recovery in many of the world's oil fields.

Surface Active Chemicals

Many of the uses for surface active chemicals for the improvement of recovery or to increase the efficiency of oil production that were suggested by the writer[15] at the 1951 annual meeting of the American Petroleum Institute are now realities. Synergetic use of two or more surface active chemicals has proved to be far more effective than the use of single compounds or more than one compound in succession. Such combinations of non-ionic compounds or non-ionic and cationic compounds have proved to be effective in field tests as bactericides and corrosion inhibitors, to control the hydration of clay minerals, to increase effective permeability to water, and in laboratory tests to increase the recovery of oil. The evidence so far developed is convincing that the most effective application of surface active chemicals will be during the initial stage of water injection. Also, the evidence is indicative, although not positively conclusive, that non-ionic compounds are most effective in releasing oil from hydrophobic surfaces. Laboratory work on reservoir material believed to possess hydrophillic tendencies has resulted in little or no increase in oil recovery.

It is becoming more and more apparent that the non-ionic compounds, which do not ionize in water solution and which are soluble in water because of their unionized polar groups, are the most effective in lowering the interfacial tension between oil and water, and in altering the interfacial tension between the liquid phases and the solid surface of the reservoir. The chromatography or adsorption-desorption phenomenon of the non-ionic compounds is receiving intensive study at The University of Texas. This work is not advanced sufficiently to provide any quantitative results. Field results and qualitative laboratory tests indicate, however, that certain* of the non-ionic compounds are not adsorbed permanently, but do come through the reservoir from water input wells to producing wells with little loss in concentration other than the dilution that is inevitable from the water that is in the reservoir.

As indicated previously, combinations of surface active chemicals are proving to be far more effective and economical than single compounds alone. The reasons for this synergetic action are not entirely understood, although it is known that some of the non-ionic compounds have much greater effect on liquid interfaces and others have much greater effect on the interfaces between the liquids and the solid. Many of these remarkable surface active chemicals are only recently available in more than laboratory test quantities, and only a few years ago they were little more than ideas in the minds of brilliant and resourceful chemists. Thus, it is obvious that much is to be learned about their practical application and their field performance. Nevertheless, they do have tremendous promise, and along with the Orco Process it is believed that their application will have a profound influence on future oil recovery practice.

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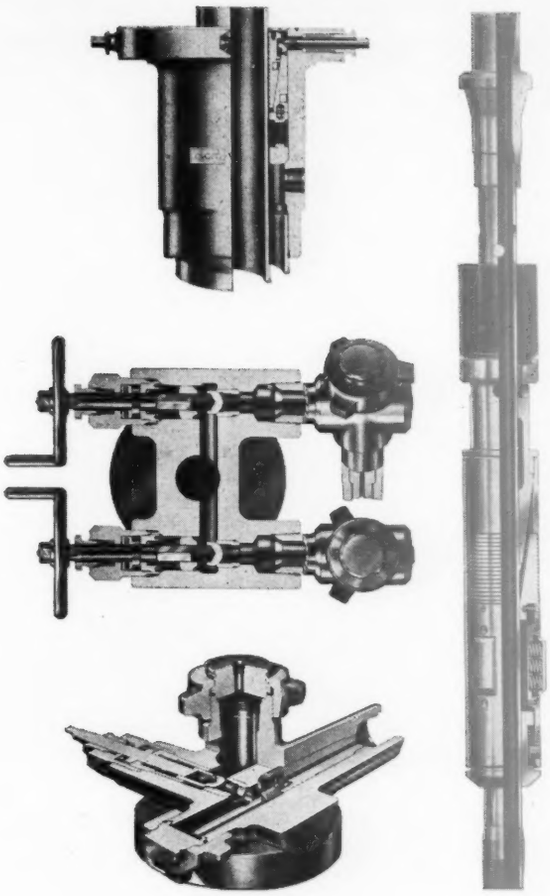
*Armour Products.



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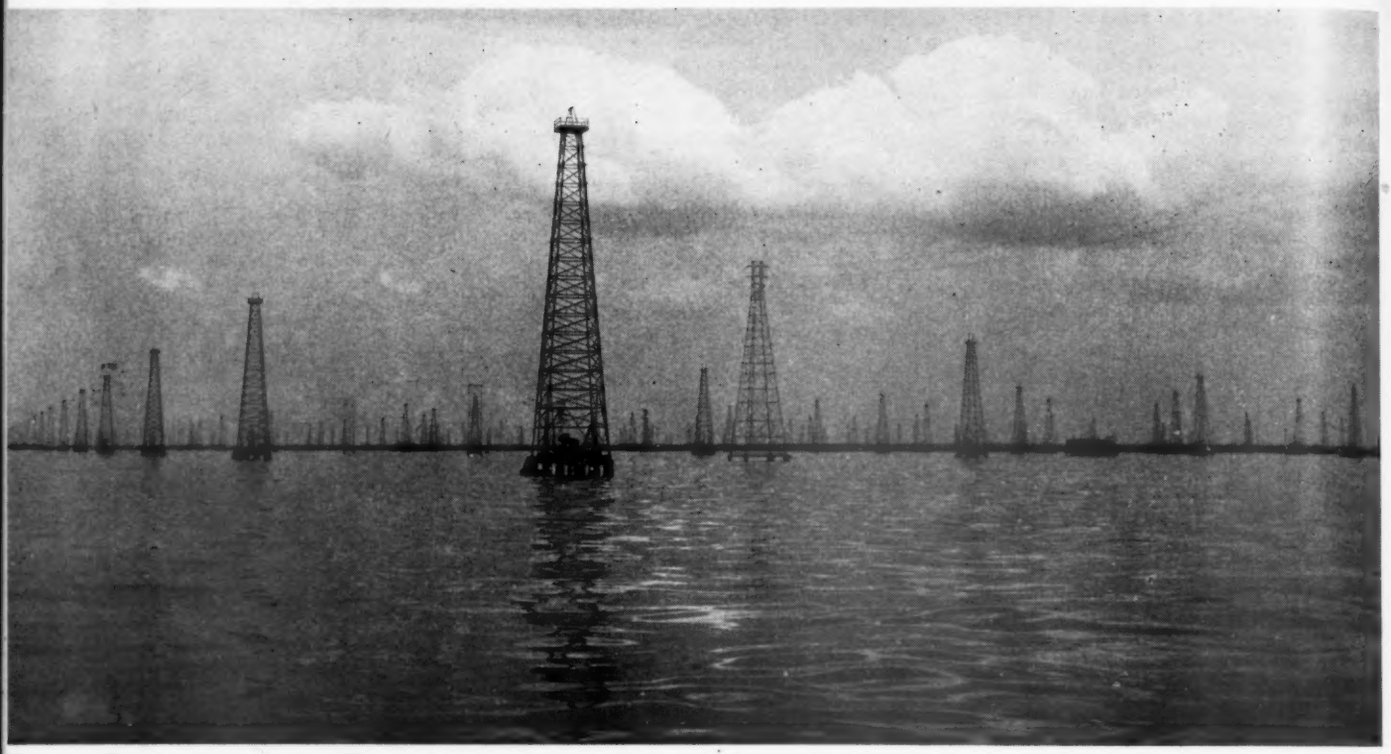

Lake Maracaibo showing oil derricks, which stretch beyond the horizon.

New Design Barge to Drill in Lake Maracaibo

Shell will use a 15,000-ft type diesel-electric rig and 30-day self-sustained drilling operations will be possible

HERBERT WEIL*

Soon a self-contained diesel electric power barge built in Britain for the Shell Organization is to be launched from the Newark (Scotland) works of Ferguson Brothers, the builders. The barge has been designed for drilling operations in the deeper waters of Lake Maracaibo in Venezuela. Although not an entirely new departure in the sphere of marine or inland water drilling technique, this barge is the first of its type to be built and equipped in Great Britain.

The craft, which houses the main diesel electric power plant together with other major and ancillary equipment and materials associated with oil well drilling operations, will be used in conjunction with a pile steel structure permanently erected at each well site.

Dimensions

The barge construction is in accordance with Lloyd's rules and requirements Class A (drilling barge for service on Lake Maracaibo and other enclosed waters) and has a displacement of approximately 2,545 tons, the principal dimensions being as follows:

	Ft	*In.*
Length moulded	158	0
Width moulded	80	0
Depth moulded to main deck at sides	10	0
Designed draft (d) about	7	6
Moulded height of pipe deck above main deck at center line	10	0

The design embodies arrangements and facilities for making it a self-sustaining power unit for drilling operations over a period of 30 days without refueling, etc. Stowage and consumable stores comprise the following main items:

	Tons
Well casing and drill piping	290
Fluid drilling mud	550
Sacked dry drilling mud/Barytes	90
Diesel fuel oil	150
Lubricating oil	2
Drinking water and engine circulating water	25
Sanitary water	3
Miscellaneous well drilling supplies	150
Crude oil	75

Welding

Welding is used to the maximum extent in the construction of the barge and except for a forward ramp-end to facilitate mooring in the vicinity of the drilling rig platform, the under-water profile is rectangular box shaped. The hull below the main deck is divided by longitudinal and transverse bulkheads into the following compartments:

Eleven water ballast tanks, 1 oil fuel tank, 2 fresh water tanks, 1 sand pit, 1 mud storage tank, 2 mud mixing tanks, 1 mud mixing pumproom, and 5 coffer-dams.

The main deck accommodates the main engine or power house, a Barytes store, core shed, electrician's store, en-

*London, England.

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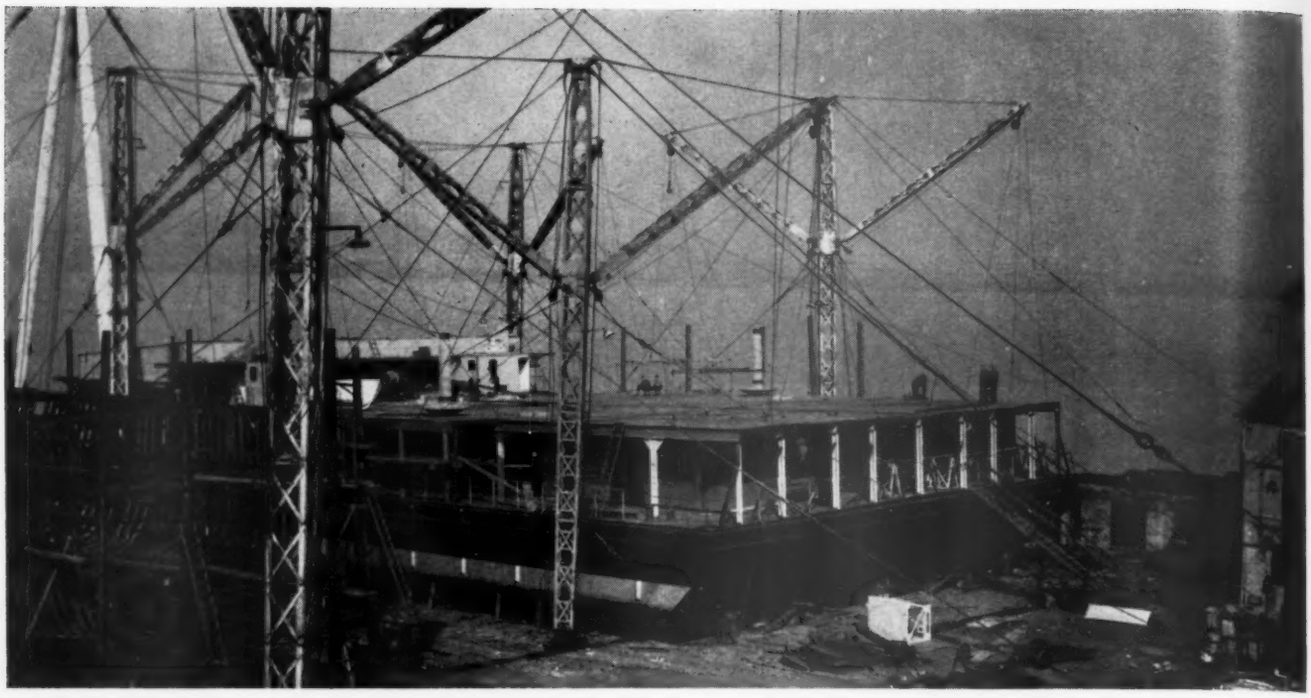


General view of barge during construction at Port Glasgow, Newark, Scotland.

gineer's store, crew mess and washplace. The top deck or pipe deck extends practically over the full width of the barge and is specially arranged for stowing and handling the drill pipe, casing and tubing. Provision is also made on this deck for an engineers' mess, dressing room and wash-board on the starboard side and on the port side a drilling engineers' combined office and mess and radio room. To facilitate the loading and stowing of drill pipe, casing, Barytes, and other stores, an electric motor-driven luffing crane of 3 tons capacity at 25 ft 0 in. radius is installed on both the port and starboard sides of the pipe deck.

For mooring the barge, four electric motor-driven anchor winches are situated on the main deck. Dual control permits operation from either the control platform situated on the pipe deck or at the winch station itself. Danforth anchors of the 3000-lb type are used in conjunction with 3½-in. circumference mooring cables.

The engine room or power house aft of the main deck is approximately 37 ft 6 in. in length by 70 ft 0 in. in width and has a mean height of 20 ft 0 in. Sliding doors 17 ft 0 in. wide and 9 ft 0 in. high are fitted at the port and starboard sides of the engine room, which is also equipped with a 3-ton athwart ship overhead traveling crane to facilitate maintenance and overhauls on the main plant.

Power Generating Plant

The main power plant consists of four 12-cylinder V-formation, pressure-charged 4-stroke diesel engines operating at 650 rpm, each direct coupled to a 450 kw d-c generator. The main engines are fitted with turbo-chargers and have a normal 12-hour rating of 910 bhp (British) and a continuous rating of 698 bhp when allowing for site temperature and humidity. In addition 2 auxiliary generating sets are provided, each consisting of a 7-cylinder normally aspirated vertical diesel engine operating at 600 rpm direct coupled to a 150 kw a-c and 20 kw d-c generator in tandem. These engines have a normal 12-hour rating of 367 bhp and under site conditions will have a continuous rating of 281 bhp.

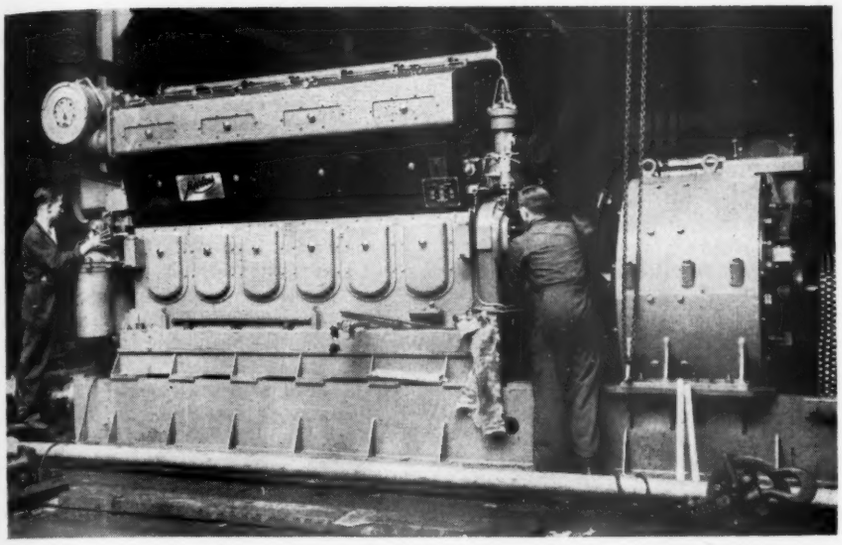
The starting of the engines is effected by compressed air at 300 psi. Two air compressors are included, one diesel engine driven at 1000 rpm, for intermittent duty only as normally required for charging air receivers, the other electric motor driven at a speed of 575 rpm, for continuous duty with automatic unloading device. The compressed air is stored in 2 inter-connected air receivers each of 100 cu ft capacity.

The engine fresh water enclosed cooling water system is equipped with 2 heat exchangers (one stand-by), each of sufficient capacity to deal with all engines running simultaneously. The heat exchangers are of monel metal construction with gunmetal water boxes to counteract the highly corrosive properties of the lake water that will be used for heat extraction. Duplicate fresh and lake water circulating pumps are provided, all 4 pumps being identical in design and each capable of handling 45,000 gal per hour. Engine safety devices include visual and audible alarms against failure of cooling water, against rise in cooling water temperature, and against failure of the lubricating oil system.

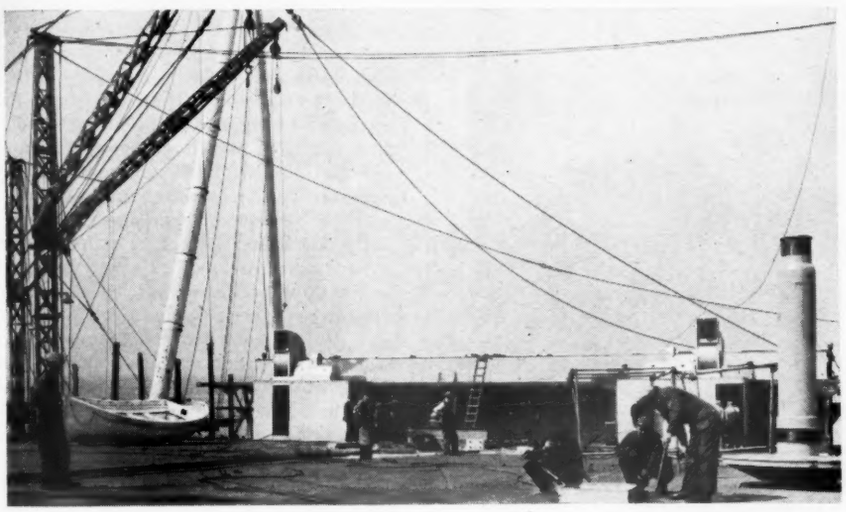
The main 450 kw d-c 450 v (FL)/520 v (NL) variable voltage generators are designed to give the full load output of 450 v. Each generator is of two-field design, a shunt field separately excited from the pony mounted amplidyne exciter and a differential series field. This combination gives the required form of drooping characteristic to provide the necessary flexibility of controls to the connected d-c motor and automatic protection against overloading the engine. Each amplidyne exciter is equipped with a control field, a current limit field, an equalizing field and an anti-hunt field. These fields are also utilized in a "suicide" circuit to kill residual voltage and bring motors to a standstill when the master switch is in the "Off" position.

The two auxiliary a-c/d-c generating sets supply alternating current of 440 v, 3-phase, 60 cycles, to the various auxiliary motors including circulating water-pump motors, blower motors, etc. The tandem-mounted d-c generator on each auxiliary set supplies the necessary current at 250 v for field excitation of the main d-c motors. Although one auxiliary generating set is intended to serve as a standby, provision is made for the paralleling and synchronizing of both sets for simultaneous operation should additional power be required. Transformers incorporated in the auxiliary panels step down the generated a-c supply to 110 v for barge and derrick lighting purposes and for comparison voltages for the amplidyne exciters of the main d-c generators.

Each generator is equipped with "drill-hoist" contactors, which are under the control of their associated "drill-off-hoist" selector switches on the driller's panel. Thus from one to four generators may be transferred from drilling to hoisting by operation of their respective selector switches. When these selector switches are in the "off" position, neither the hoist nor the drill contactor will be closed.



Installing one of 4 main TVT 12 Mirrlees diesel engine driven 450-kw generator sets in the engine room of the barge.



Pipe deck of barge during construction.

One of 4 TVT 12 engines in engine room of barge.

Main Motors

Installed below the main deck of the barge are 3 variable speed d-c motors. two of 800 hp rating (British) suitable for a speed variation from 720 to 72 rpm. These are each independently connected through a 2-in. pitch quadruple chain drive to the two main mud pumps, which handle the mud flush requirements to the rig during drilling operations. On the port side of these 2 pumps a 300 hp motor with a speed range of 750 to 75 rpm is directly coupled to a high pressure multi-cylinder pump provided for cementing operations.

A 150 hp motor having a speed range of 900 to 90 rpm is coupled through a V-belt drive to an auxiliary mud pump installed on the starboard side of the main pumps. A second identical 150 hp motor supplies the drive to the coring reel unit, which is installed on the top deck of the barge. Speed variation of these motors is obtained by generator voltage control.

Central blower equipment, with a duplicated standby set, capable of handling approximately 18,000 cu ft of air per minute, is installed for the ventilation of these main d-c motors, except the 300 hp motor, which will be forced ventilated by an individual motor-driven blower. The central blower equipment will also take care of the ventilation requirements of the barge.

In addition to the above-mentioned 2 d-c motors there will be installed on the drilling platform the drawworks motor with a normal rating of 800 hp and similar to the main mud pump motors. The rotary table motor, rated at 300 hp and having similar characteristics to the high pressure cement pump motor. These 2 motors are forced ventilated by individual electric-motor driven blowers, which ensure full and constant ventilation of the motor regardless of speed and permit safe air to be supplied when gaseous conditions are encountered.

Pumps

The two 8½-in. by 16-in. horizontal duplex main mud circulating pumps are equipped with 3500 psi working pressure fluid ends and have a nominal input of 825 hp at 65 rpm. Suction and delivery manifolds between these two pumps are arranged for compound or parallel operation.

The auxiliary 7¼-in. by 12-in. horizontal duplex pump, which has an input rating of 165 hp at 65 rpm, is provided for mud mixing and other utility purposes. The high-pressure multi-cylinder cementing pump is designed for working pressures up to 10,000 psi and is equipped with three 4¾-in. plungers and three 3½-in. plungers each bank being manifolded for compound, parallel, or independent operation.

In conjunction with the mud circulating pumps, a mud ditch system is incorporated on the main deck, complete with dual shaker screens, settling pits, and chemical tank, etc.

General

During actual drilling operations the barge can be moored, by means of the

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four 3000-lb anchors, at a distance varying from 25 to 120 ft from the permanent drilling platform, which in itself is of novel construction. It comprises chiefly a prefabricated structure having four corner groups of three 20-in. diameter steel caissons of suitable length to meet the depth of water at the proposed location. The whole rectangular box-shaped structure is fabricated on shore, transported by crane barge to the desired site and placed bodily into position on the sea-bed, the lower end of the caissons becoming partially embedded by virtue of the weight of the whole structure. This assembly forms a jig for the 13-in. steel tubular piles, which are inserted into the upper open end of the 20-in. caissons and driven to refusal in the lake bed by means of a piling barge. Fin-type guides are spaced at intervals on the outside of the 13-in. piles to ensure concentricity within the caissons. Concrete is then placed inside and around the 13-in. piles to form a solid reinforced pile structure, which should adequately serve the expected production life of the well. Finally, on the top of this piled substructure and at a suitable height above water level, a structural steel platform is erected to accommodate the 136-ft high by 30-ft base drilling derrick, drawworks, rotary table, and their associated electric motors, etc.

Flexible cables and control lines from the power barge to the drilling platform supply the necessary power to the motors installed on the latter and also provide the driller with remote control of certain equipment on the barge. For example, the two 800 hp mud motor pumps will each have a master switch at the drawworks position and on the barge, permitting control from either station, but not simultaneously from these points. On both the derrick platform and barge are mounted suitable panels equipped with plug receptacles to receive the coupler plugs of the interconnecting power cables and control lines. A telephone system between the driller platform and the barge will permit the driller to have direct contact with seven principal operating stations on the barge and communication with shore headquarters will be maintained by radio.

This self-contained, mobile power unit barge when used in conjunction with the drilling platform will be capable of drilling to depths of 15,000 ft in the deepest waters of the Lake at locations 15 miles or more from the shore.

Selection of diesel-electric power, as opposed to steam generating equipment, has, despite its higher initial capital outlay, many advantages to offer. Chief among these is the elimination of the feedwater problem that confronts the operator of steam-raising plant on marine craft, in which category this unit can be classed. Although more skilled supervisory and maintenance personnel will be required, resulting in higher daily operating costs, it is expected that on a long-term basis this will be offset to an appreciable extent by savings in fuel consumption, plant maintenance and replacement costs. Another advantage is the reduction of fire hazard that exists when steam-raising equipment is used in close proximity to drilling operations. The flexibility and ready means of disconnecting the power supply cables and control lines between the barge and drilling platform, constitute a considerable advantage should adverse weather or any other emergency necessitate the withdrawal of the barge to a safe distance from the well site.

Finally an intrinsic feature, and one not to be altogether ignored, in favor of the diesel-electric installation, is the facility it affords the crew and operating staff for "good housekeeping," which contributes materially to overall efficiency. * * *

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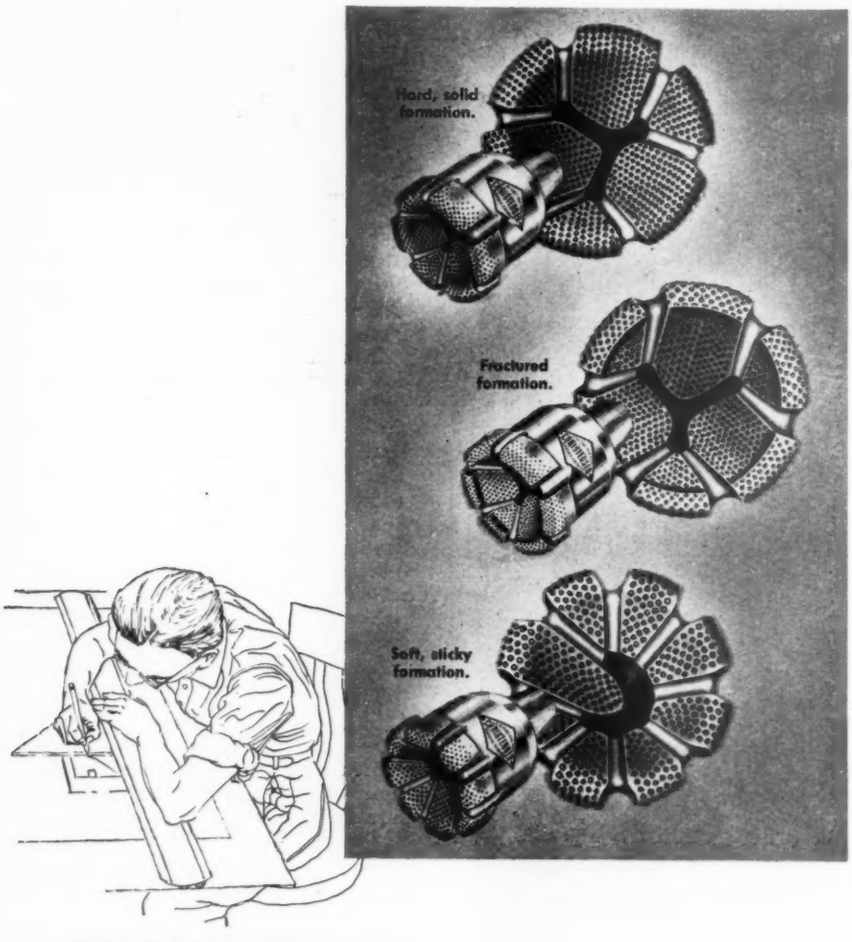
Oil Man Sets Up School Fund

John P. Herrick of Olean, New York, oil producer and writer, has established a scholarship at St. Bonaventure University in New York in honor of the Franciscan missionary who three centuries ago became the first white man to report the presence of oil in North America. Harrick gave the University's School of Arts securites worth more than $10,000 to set up the scholarship in memory of Father Joseph De Roche D'Aillon, who was guided by Indians on July 18, 1627, to the Seneca oil spring.



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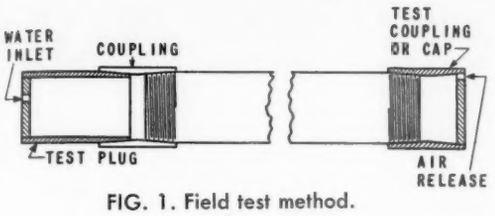

FIG. 1. Field test method.

FIG. 2.

FIG. 3.

Various Methods of High Pressure Testing Oil Country Tubular Material†

The oil operator desires to be certain that down the hole tubing and casing will withstand any anticipated high operational pressures

H. G. TEXTER*

During the past few years most manufacturers and users of casing and tubing have learned the need of some nondestructive tests that would measure the performance properties of casing and tubing. This need has increased in importance as wells go deeper and the forces tending to burst or collapse or otherwise distort the strings grow larger.

Until several years ago the performance properties were based on the ability of the product to meet certain API specifications. The requirements covered grade of steel to be used, method of manufacture, physical properties of strips cut from the rolled tubes, dimensional limits, thread elements, etc., all of which were important, but none of of which, nor all of which taken together, assured the user that the completed product would adequately resist failure in a well. For one thing, most of the tests were *not* applied to each length but only to representative samples or tubes selected at random. Even the mill inspection hydrostatic test, which aimed to be a test of the resistance to bursting, and was applied to each individual length, was quite inadequate because the pressure was limited to 3000 psi maximum internal water pressure.

Realizing the above, the API has now adopted an alternative internal pressure test, based on 80 per cent of the minimum yield strength, calculated by Barlow's formula,‡ which is a big step toward a real measure of performance value. So far this is not yet a mandatory test.

The full step would be to test *each* length of casing, in a collapse chamber,

The Author

H. G. Texter is chief field engineer for the Spang-Chalfant Division of the National Supply Company. His work consists principally of studying tubular needs of producing companies and rotary drilling contractors and investigating the causes of failures in the field of tubular products and possible means of preventing them. He was graduated from Carnegie Institute of Technology in 1913, and worked with National Tube Company on various research and field problems for eight years. He joined National Supply in 1923 as a metallurgist and field engineer.

†Presented at the American Society of Mechanical Engineers, Petroleum Division of Mechanical Engineers, Petroleum Division ference—Kansas City, Missouri, September 22-24, 1952.

*Chief field engineer, Spang-Chalfant, Division of The National Supply Company, Tulsa, Oklahoma.

‡See appendix for discussion of this formula.

to some 80 per cent of its minimum collapse value and, in a tension pulling machine, to 80 per cent of its joint strength, in addition to the 80 per cent burst test. The cost of the collapse and tension tests, however, would be prohibitive, to say nothing of the loss in time involved. So the only truly worthwhile, economical, performance test would be the high internal pressure test.

In a paper, by the author, presented at the Third World Petroleum Congress,[1a] arguments were given to show that ability to withstand high internal pressure is very great assurance that a pipe will likewise withstand tension and collapse forces of equal degree of intensity. Also given in this paper were the author's observations concerning failures in service which could have been caught had the tubes been high pressure tested and, above all, many cases were discussed in which perfectly good tubes that had been rejected because of doubtful surface blemishes were proved to be perfectly capable of serving their purpose. In these days of material shortages, it is shameful to discard casing and tubing on appearance and then accept lengths inherently, but not visibly, faulty.

Assuming, then, that high pressure testing is justified, it should be interesting to consider the various methods of carrying on such tests. There are a number of unsuspected factors involved.

Furthermore, it will be evident that as the wall thickness increases and the size goes down, and as the grade of steel improves, the test pressure may climb to pretty high figures. For example, to test 5½-in. OD, 23-lb, N-80 casing to 80 per cent of the minimum yield strength requires a pressure of 9700 psi. Handling such a pressure properly and safely, and still keeping up a reasonable rate of operation, presents some interesting mechanical and mathematical problems, the discussion of which is the principal purpose of this paper.

[1a]Numbers refer to references at end of paper.

Field Pressure Test

The simplest but slowest procedure is usually called the field method because it is used universally in mobile field units. Of course it can also be used in pipe mills if other equipment is temporarily unavailable or is of insufficient pressure capacity.

Briefly, it consists of screwing a plug into the coupling and a cap onto the field-end threads, with connections for admitting water and releasing air. Pumps then apply pressure as required. Diagrammatically, this method may be illustrated as in Fig. 1.

The advantage of the field method is that it requires a minimum outlay for equipment. The cost of a mobile pressure unit is nominal and the cost of plugs, pipe, and fittings is negligible.

There is no need of supporting the pipe against buckling, as is true of the usual mill methods of testing. In fact, only skids or a pipe rack is needed. See Figs. 2 and 3.

In very high pressure testing, the tube itself is proof tested in tension to some extent. Thus, in testing 7-in. OD, 29-lb, N-80 casing to 7500 psi there is exerted a tension stress of 7500 times the internal cross sectional area of 30.035 sq in. or 225,262 lb. This calculates to 33-1/3 per cent of the minimum yield strength of Grade N-80 steel.

Right here it might be well to disabuse the layman's mind of the common conception that longitudinal tension increases the tendency of API threaded joints to leak. This is not so. Several comprehensive research programs have proved conclusively that there is no more tendency towards leakage at tension loads up to the yield point of the metal under the last engaged thread than at zero tension.[2]

More than offsetting the seeming advantage of testing the pipe in some tension there is a real disadvantage introduced because of a biaxial stress effect. This results in there being a false yield strength, in resistance to internal pressure, which could result in passing a defect of borderline intensity.

To understand this effect refer to Fig. 4, which is known as an Ellipse of Biaxial Yield Stress.[3] It expresses, diagrammatically, the resultant effect of combined longitudinal and hoop stresses in a tube. It is used, principally, in calculating the reduction in resistance to collapse of casing strings under tension, but is just as applicable to other stress combinations. The lower right-hand quadrant, for example, expresses the resultant of combined tension and external collapse pressure, and the lower left-hand one is the resultant of longitudinal compression and collapse.

For a tube under combined tension and internal pressure the upper right-hand quadrant applies since it expresses the conditions where a tube is being pressure tested by the field method. Continuing the example of testing 7-in. OD, 29-lb, N-80 casing at 7500 lb, where the longitudinal stress reaches one-third the yield strength in tension, it is evident that there is quite an appreciable increase in the hoop yield strength, which is a measure of the tube's resistance to bursting.

Reading in the upper right-hand quadrant of Fig. 4, a tension stress of 33-1/3 per cent of the yield strength of the steel would indicate a 12½ per cent *increase* in the stress at which hoop yielding would occur. Such an increase could definitely prevent a defective tube from failing in a longitudinal type of defect which was on the verge of bursting open.

A very great advantage of the field method is that *any* pressure up to the bursting strength of the tube can be obtained by using a sufficiently high pressure pump. Therefore, this is the method commonly used in the mill laboratories for tests to destruction of heavy wall, high strength tubes.

Another seeming advantage of the field method is that leaks through the pipe-coupling threads may be noted very readily. This is more difficult to detect in some of the mill type test benches. This is not as important a point as might first appear, however,

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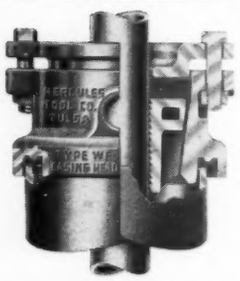

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and it would be well to consider the subject from several angles.

Resistance to leakage is a function of thread accuracy, degree of make-up of coupling, type of lubricant, and a time or handling factor. Now, experience has shown that modern pipe mills have no difficulty whatsoever in conforming to the API thread specifications. Power tight make-up of couplings can be controlled accurately and almost any soap base grease with powdered lead, copper, zinc, or graphite fillers will seal effectively for an appreciable period of time. So, and this is borne out by years of experience, leaks through the threads almost never occur at a pipe mill test bench. This is expected to be even more true with the completion of the API research program on thread lubricants.

One of the principal reasons for this is that the time factor is too small, never more than one minute and seldom over five seconds. After all, the only reason fluids do not escape immediately through the spiral opening between the tops and bottoms of mating threads is because of the plug of grease in this opening which has to be pushed or dissolved out to permit leakage. Even a relatively poor lubricant or non-petroleum base filler will resist surprisingly high pressures for at least short periods of time.

Furthermore, pipe thread lubricants may seal effectively when first applied, and the joint first made-up, but fail to hold after the handling incidental to truck, railroad, or steamship hauling. This is what is meant by a "handling" factor.

Hence the conclusion that high pressure testing a pipe with coupling in place is not a legitimate test of the joint. And, even if it were, it should be remembered that one end of the pipe (the field end) is not being tested as it will be made-up in service, but only with some sort of test cap.

Hence, also, the reason for stating that it is not very important to check for joint leakage during high pressure testing—at least not for new pipe. For rerun or secondhand pipe the case is quite different and the high pressure testing should be considered as a check on the threading as well as the body of the pipe. In such cases, the testing would undoubtedly be done in the field, by the field method, where any leakage would be most easily discernible.

The great disadvantage of the field method, as originally stated, is its slowness of operation. The plugs and caps must be screwed on and off, by hand, for each test, consuming considerable time. Even with ingeniously designed plugs and caps, with sections of rubber threads which do not need to be screwed up more than hand tight, there is considerable time loss. Depending on the size, only 10 to 15 lengths per hour can be tested.

Also, as a rule, no safety precautions are inherent in this method and the workmen and observers must be careful not to stand directly beside the tube, to avoid possible shattering, nor directly in front of the plug or cap in case they, or the connections, might be blown off.

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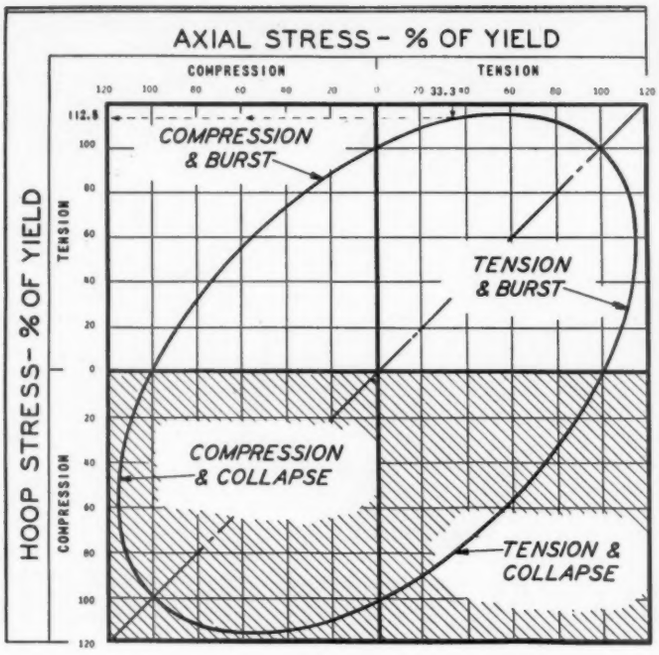


FIG. 4.

FIG. 6.

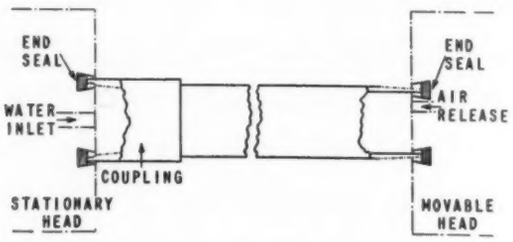


FIG. 5. Common mill type tester.

Present Mill Test Procedure

The most commonly used mill type of test bench is illustrated, diagrammatically, in Fig. 5. This is the usual arrangement for pressures up to the 3000 psi, maximum requirement for API standard pressure tests. Such units have operated successfully up to 5000 psi, but this is close to the upper practical limit. Fig. 6.

It consists of two large heads supported by suitable beams for carrying the tension loads. In the centers of the heads are rings containing gaskets against which the ends of the pipe are pressed and which serve as fluid seals.

One of the heads is stationary and the other hydraulically movable, the latter being moved towards the stationary one after the tube has been dropped into position. The hydraulically movable head not only accommodates itself to variable pipe lengths and to compression of the packing but also to the slight shortening of the tube as pressure is applied, as discussed later in this paper. Suitable connections through the heads serve for water input and air release, as in the field method.

This type of equipment is not overly expensive but is, of course, far too heavy and cumbersome to be portable and can only be used in the pipe mill. As it is used for pressures up to only about 5000 psi, no particular safety precautions need be taken except that men should not stand directly beside a pipe under test. There is no danger of end connections ever blowing out.

The great advantage of this method is its speed of operation. For example, 7-in. OD casing can be tested at the rate of 70 to 75 pieces per hour even when each tube is held at full, required pressure for at least five seconds. Compare this with only 10 or 15 per hour by the field method.

Instead of the tube body being subjected to longitudinal tension, in this type of testing, it is subjected to some compression. The higher the pressure the greater the compression because the hydraulically movable head, as well as the stationary one, must continue to force the packing gaskets against the ends of the tube to prevent leakage. Thus, to test 7-in. OD, 20-lb, J-55 casing to 3000 psi (standard API requirement) there must be an end loading of something slightly greater than the internal cross sectional area, 32.735 sq in., times 3000, or 98,200 lb.

It is aimed to keep this differential at approximately 10 per cent so that there will be no appreciable leakage through the gaskets. Therefore the net column loading on the pipe will be in the nature of 10,000 lb:

98,200 + 10% = 108,020 = load of hydraulic head.

108,020—98,200 = 9,820 = net column loading applied to the pipe under test.

This compression loading tends to buckle the pipe and clamps or fingers are provided to close down, especially over small size material, to prevent springing out of the bench. See Fig. 6. This is one of the reasons this method is not applicable to the new, alternative, pressure testing in which high end loading would be required. The real reason is the inability of the gaskets to hold against pressures appreciably over 5000 psi.

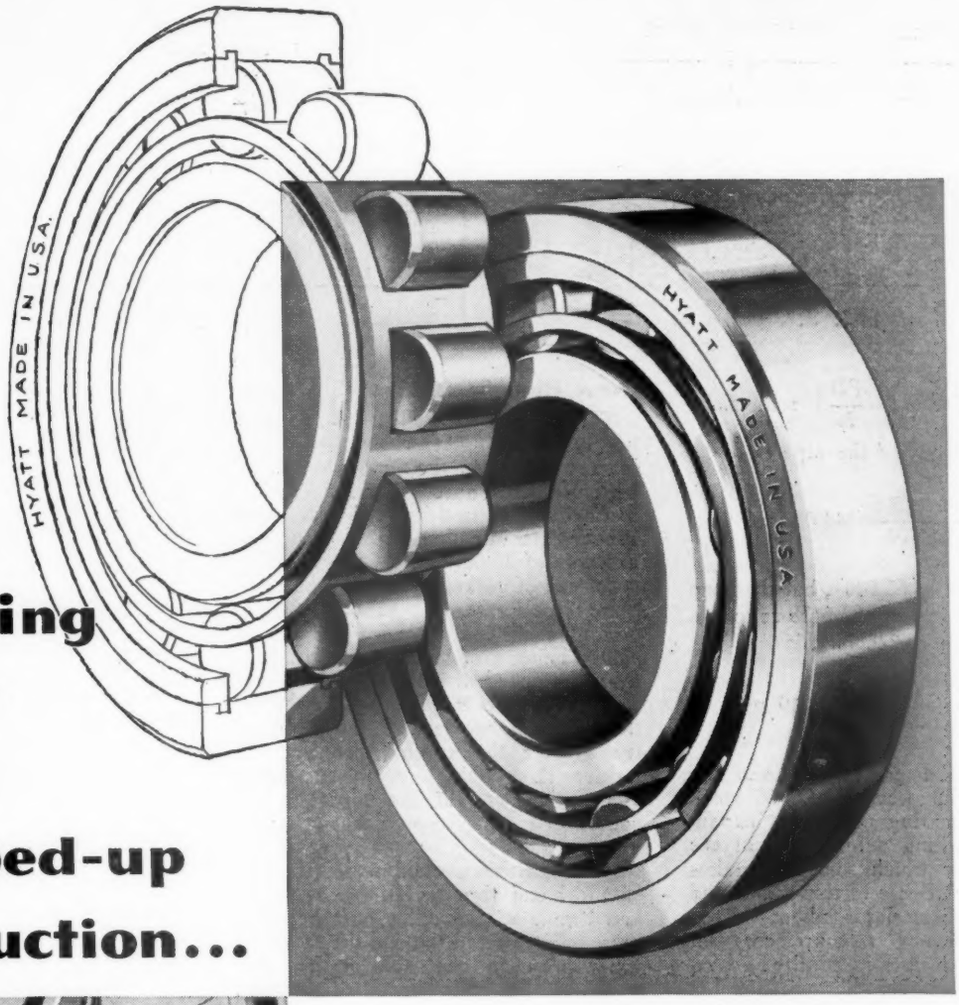
Another and very important limiting factor is that the ends of couplings, because of their recess, may be too light, as compared with the wall thickness of the body of the pipe, to resist the hoop stresses imposed by the internal pressure and will expand beyond the elastic limit. This, in itself, is not serious; but actually what happens is a partial deformation of the adjacent threads and resulting steepening of their taper beyond the API allowable.

This is explained by reference to Fig. 7, using as an example 5½-in. OD, 17-lb, J-55 casing.

The alternative test pressure for this item is 4900 psi (80 per cent of minimum yield strength).

Using Barlow's formula:

$$P = \frac{2\,St}{D}$$



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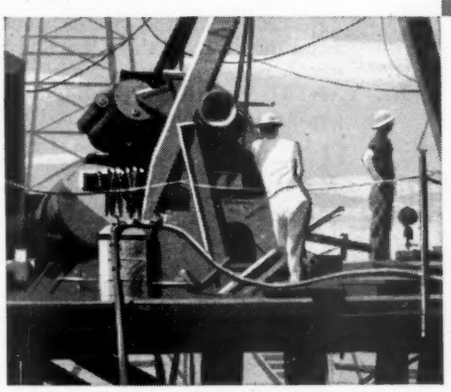

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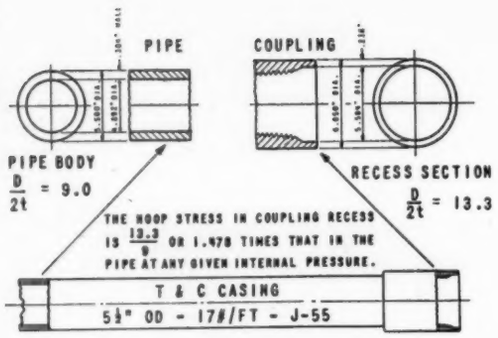
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5½" OD - 17#/FT - J-55

FIG. 7.

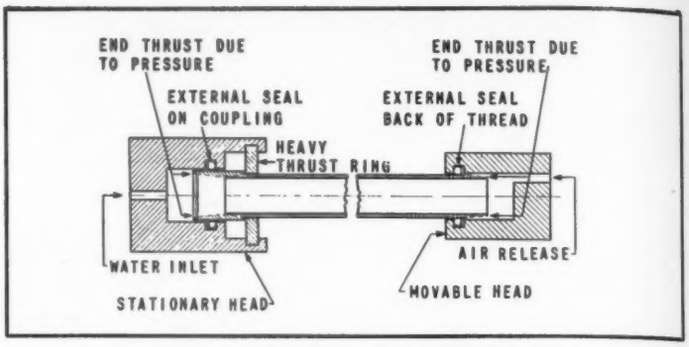

FIG. 8. High pressure test bench.

and solving for S ($=\frac{PD}{2t}$) : the hoop stress in the body of the pipe is

$$S=\frac{4900\times 5.5}{2\times .304}=44{,}000 \text{ psi}$$

(=80 per cent of 55,000), but the hoop stress in the thin section of the coupling, over the recess (0.228 in.), is

$$S=\frac{4900\times 6.050}{2\times .228}=65{,}000 \text{ psi},$$

which is 10,000 psi higher than the minimum yield strength of J-55 steel. Hence the resulting permanent expansion and resulting deformation of the coupling taper which sometimes takes place. An actual case of this was called to the writer's attention about a year ago. Field thread measurements on some delivered casing resulted in rejection of a number of couplings because of steep taper readings, beyond the API allowable limit.

New High Pressure Mill Testing

The latest type test benches, now being installed in American pipe mills, for testing up to the new, alternative, high pressure figures, may be diagrammatically visualized as in Fig. 8. These benches are intended for test pressures upwards of 10,000 psi.

Instead of gaskets sealing at the ends, there are external rubber flanges around each end of the pipe, one of course being over the coupling (if testing is required after the couplings are screwed on). As indicated in the sketch, the rubber flanges are so designed that the greater the applied pressure the tighter the rubber will be pressed against the OD of the pipe, or the coupling. In this respect the design is ideal.

Although this method avoids the mechanical end thrust of the heavy, gasketed ends of the older mill benches, there is introduced the end thrust of the water pressure itself against the cross sectional area of the metal of the tube plus another factor to be discussed later. This becomes a surprisingly high longitudinal compression when high test pressures are involved.

As far as the first factor is concerned consider the case of testing a plain end (no coupling) 7-in. OD, 32-lb, N-80 tube to 80 per cent of the minimum yield, or 8300 psi. The cross sectional area of the metal of such a tube is 9.317 sq in. Then, this figure times 8300 psi gives a longitudinal compression load of 77,330 lb, which is fairly high. Obviously, except for a very short tube, buckling could take place and, like the older benches, finger clamps must be employed to hold the tube approximately straight.

As in the case of testing by the field method, there are again biaxial stresses involved. This time, however, the longitudinal stress is one of compression, just the reverse of the field method and, as might be guessed, compression tends to *decrease* resistance to internal pressure.

The resultant of longitudinal compression plus hoop stress from internal pressure is plotted in the upper left-hand quadrant of the Ellipse of Biaxial Yield Stress (Fig. 4), and it is evident at once that a combination of the two stresses results in *lowered* resistance to failure.

Thus, using the end thrust in testing 7-in. OD, 32-lb, N-80, as above, the unit compressive stress of 8300 psi is $\frac{8300\times 100}{80{,}000}$ or 10.4 per cent of the yield strength of the metal. Reading from the curve, the resultant yield point in resistance to bursting force is reduced to about 94 per cent of normal. This is not much of a change, but it is a step *towards failure* at *less* than normal pressure.

From the consumer's viewpoint the mill testing method with sealing flanges over the ends of the pipe is appreciably better than the field method. The latter tends to *mask* the effect of defects whereas the mill method tends to *aggravate* their effect.

Going back, again, to 7-in. OD, 32-lb, N-80 casing, consider testing not the plain end material but a finished piece, with coupling screwed on. The cross sectional area of the metal on the field end (threads only) is the same as before, but on the coupled end the area of metal of the coupling must also be taken into consideration. This amounts to 7.551 sq in. (effectively the area of a tube whose OD is 7.656 in. and ID of 7

FIG. 9.

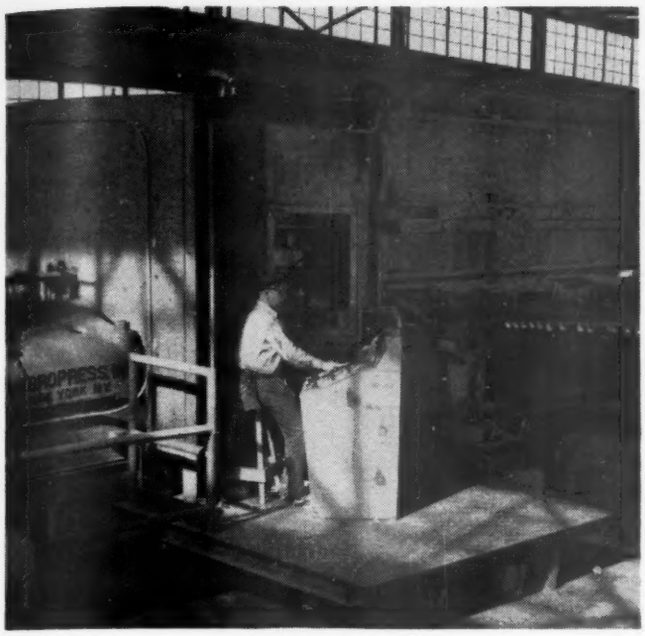

FIG. 10.

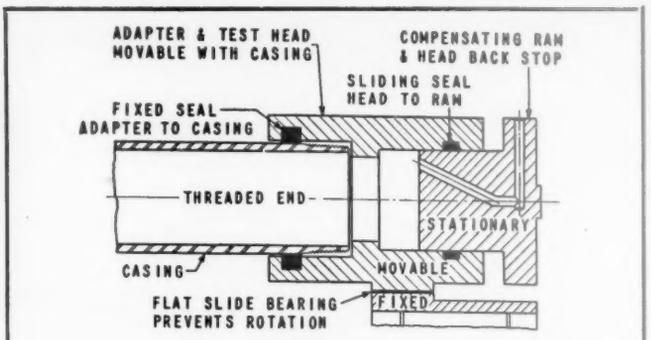

FIG. 11.

in.). This area plus the tube wall area is equal to 9.317 sq in. plus 7.551 equals 16.868 sq in.

Then, 16.868 (sq in.) times 8300 (psi) equals 140,000 lb, which is very high and, as the end loading is unequal, due to the added area of the coupling on one end, the pipe must be restrained from moving towards the uncoupled end. This requires the heavy ring, indicated in Fig. 8, the presence of which makes it difficult, but not impossible, to see a small leak through the threads and is another argument against testing with the couplings in place.

As stated before, however, it is rather useless to consider pressure testing as an adequate test of the joint itself. The time element is too short (seldom over five seconds) and newly made-up couplings seldom or never leak if made up with only very ordinary care.

Figs. 9 and 10 are views of the new high pressure test bench lately installed and starting to operate at the Ambridge plant of the pipe mill represented by the author. Note the shroud over the entire tester to serve as a barrier to flying pieces from a shattered tube.

Comparing Figs. 6 and 9 gives a good picture of the difference in size of the old and the new types of test benches. The new unit cost approximately $250,000 (about $600,000 with attendant skids, coupling screw-on machine, handling equipment, etc.). By way of contrast, the test bench in Fig. 6 would cost only in the nature of $35,000 ($245,000 total).

These new high pressure test units have many novel and interesting refinements. Most of these, such as handling the tubes in and out of the bench, method of speeding up operations, safeguards against accidents, etc., are not within the scope of this paper, which is considering principles and not details.

One feature, however, is worth noting. It concerns freedom of movement of the movable head, the one at the right of Fig. 8.

When a tube is subject to internal pressure it expands. While expanding it shortens in length, as expressed in the equation:[5]

$$\frac{L'}{L} = \frac{2v}{E} \times \frac{P}{R^2-1}$$ in which

L = original length of the tube, in inches

L' = decrease in length, in inches

v = Poisson's ratio = 0.3

E = Young's Modulus = 30,000,000

P = Internal pressure in psi

R = Ratio of OD to ID = $\frac{OD}{ID}$

Then, for a 7-in. OD, 29-lb, N-80, Range 3 length of casing, being tested to 7500 psi (80 per cent of minimum yield, alternative API test pressure), we would have:

$$\frac{L'}{L} = \frac{0.6}{30{,}000{,}000} \times \frac{7500}{\left(\frac{7.00}{6.184}\right)^2 - 1} =$$

$$.000{,}000{,}02 \times 26{,}700 = .00534$$

or, for Range 3 casing, which is about

$$40 \text{ ft}, \frac{L'}{40 \times 12} = .00534$$

$L' = 0.256$ in.

or, the contraction in length of a Range 3 tube is slightly over a quarter of an inch.

A quarter of an inch may seem a small amount, but it will be realized that the rubber sealing flange must slide this same amount and with increasingly high unit contact pressure between it and the tube. Such sliding, with high contact pressure, would wear the bearing surface of the rubber extremely rapidly and to avoid this the movable head is allowed to "float." Thus, as the tube becomes shorter, the head and also the rubber flange moves with it.

Means for permitting this movement is diagrammatically illustrated in Fig. 11. This diagram is a more detailed view of the right-hand end of Fig. 8 and is self-explanatory. Without this ingenious arrangement the test bench would be out of service an unconscionable amount of time for replacing the rubber seals of the movable head.

Alternate Method of Sealing

Earlier, it was pointed out that testing a 7-in. OD, 32-lb, N-80 tube to 8300 psi introduces a longitudinal loading of at least 77,330 lb and that very substantial finger clamps must be provided to prevent the tube from buckling. Figs. 12 and 13 are photographs of such clamps, both in the open and closed position. Failure to use the clamps or having them improperly spaced permits tubes to buckle beyond recovery, as in Fig. 14. (Actually these tubes were subjected to unexpectedly high buckling forces, as discussed later.)

To avoid the longitudinal loading due to the end thrust of the water pressure on the ends of the tubes it is feasible to employ *internal* rubber sealing flanges as diagrammatically indicated in Fig. 15. Thus only "pure" hoop tension is imposed on the tube and there are no complications involved with respect to longitudinal tension or longitudinal compression as far as the tube itself is concerned. In other words, a resultant of biaxial stresses is not involved.

It might seem, then, that there would be no buckling tendency and finger clamps would be unnecessary, also that the test unit could be simplified considerably. This, however, is far from true. The longitudinal end thrust of the water on the cross sectional area of the tube wall would be eliminated, of course, but there still remains another serious buckling force, the existence of which will seem quite surprising to most of us.

The explanation of this force is contained in a letter (see Appendix B) heretofore unpublished, by Arthur Lubinski, a Stanolind Oil and Gas Company research engineer, to the writer. In this letter the two following important conclusions are drawn:

"Using internal seals and applying an internal pressure to a length of pipe

Letter to a Skeptic

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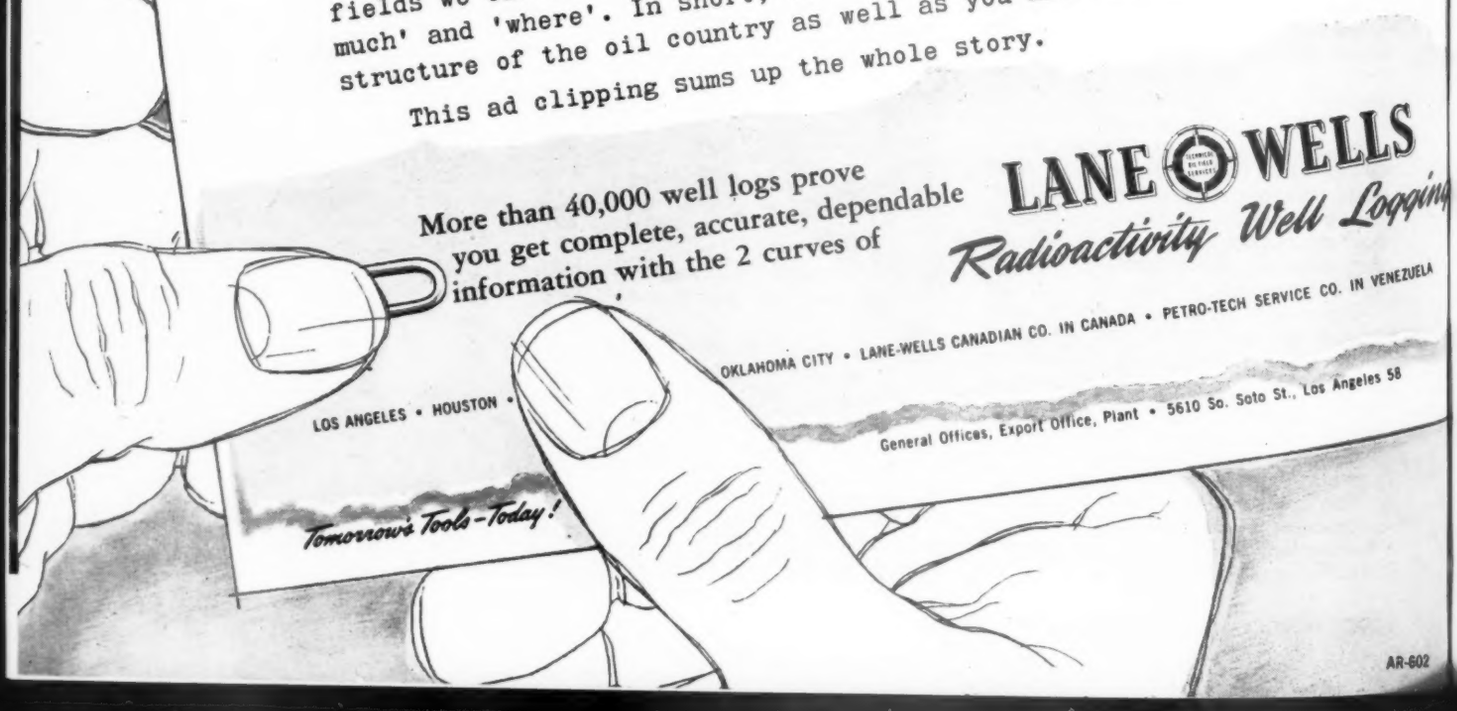
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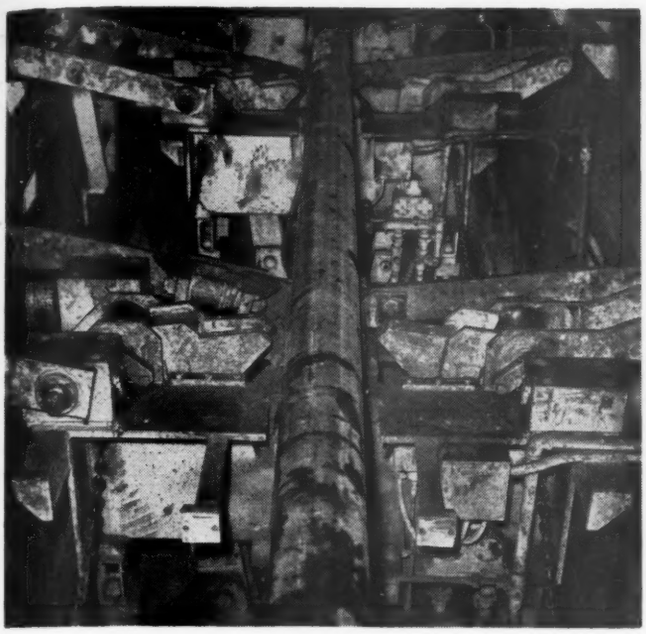


FIG. 12.

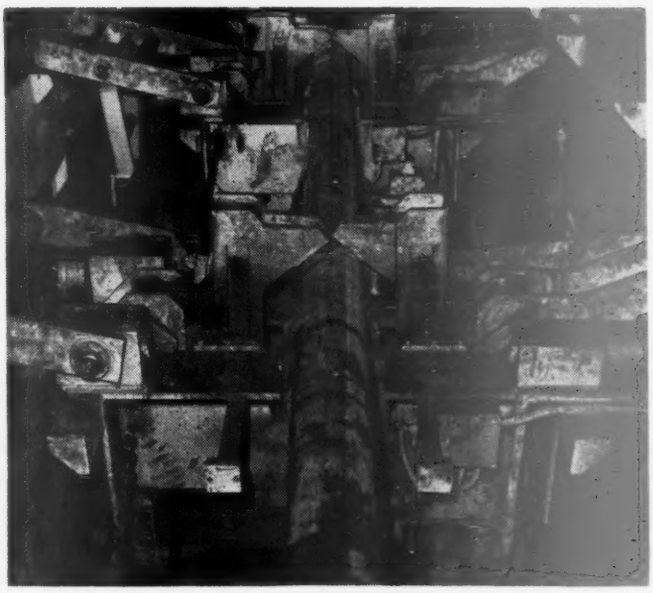


FIG. 13.

open at both ends has the same effect on buckling as compressing the length by two forces applied at its end and equal to the product of the internal pressure in psi and the cross-sectional area in square inches corresponding to ID.

"If the internal pressure is large enough, the pipe buckles without being under compression."

Further consideration of this rather little known, unsuspected, phenomenon is contained in this same engineer's paper "Influence of Tension and Compression on Straightness and Buckling of Tubular Goods in Oil Wells" presented at the November, 1951, convention of the API in Chicago.[5] In this paper he demonstrates, mathematically, that a casing string which is straight, with liquids of equal density inside and out, may buckle if the inside fluid is replaced with a heavier one. This latter condition is precisely the same as the proposition of testing tubes with internal water pressure.

Considering now the case of external rubber seals, as first described for high pressure testing, Lubinski concludes:

"Using external seals and applying an internal pressure to a length of pipe open at both ends has the same effect on bluckling as compressing the length by two forces applied at its ends and equal to the product of the internal pressure in psi by the cross-sectional area in square inches corresponding to OD.

"If the internal pressure is large enough, the pipe buckles under much less compression than would be needed under actual column loading."

"Critical conditions, that is to say, the mimimum pressure for which a length buckles or the minimum length for which a pipe buckles when subjected to a given pressure, may be calculated with conventional buckling formulae for various end conditions. In these formulae, *the longitudinal force must be replaced by the product of the pressure and the cross-sectional area corresponding to OD.*"

From the above it may be seen that the calculations of the magnitude of end loading, so far referred to in this paper, are correct only for calculation of stresses involved in the Ellipse of Biaxial Stresses. On the other hand, they are quite *incomplete* and *erroneous* for buckling calculations. Thus, in considering the testing, in one of the new high pressure testing units, of a plain end (no coupling) 7-in. OD, 32-lb, N-80 tube to 80 per cent of the minimum yield it was concluded that the longitudinal compression load was 77,330 lb. (Cross sectional area of the tube wall, 9.317 sq in., times the test pressure, 8300 psi).

Now we can see that to this figure must be added the compression load equal to the product of the area of the ID of the tube times the test pressure:

$$29.167 \text{ (sq in.)} \times 8300 = 241{,}900 \text{ lb},$$

which is a *much* greater buckling force than the original 77,330 lb.

The total, 319,230 lb, may more simply be calculated by multiplying the external cross sectional area of a 7-in. OD tube by the pressure:

$$38.485 \times 8300 = 319{,}230 \text{ lb}.$$

Small wonder, then, that tubes may buckle in the test bench. An end load of 319.230 lb is equivalent to standing 8400 ft of 7-in., 38-lb, casing on end.

Or, considering the testing of 2⅞-in., 6.50-lb, N-80 tubing to 80 per cent of the minimum yield, the buckling load would be equivalent to standing 9700 ft on end.

FIG. 14.

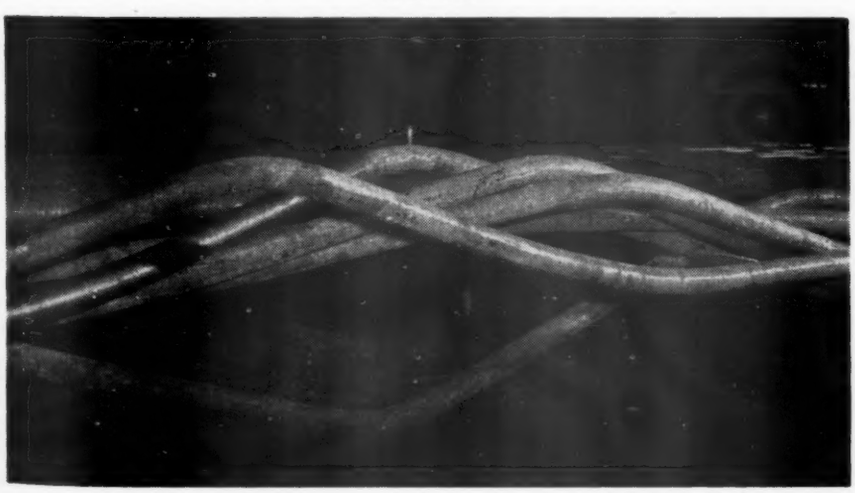
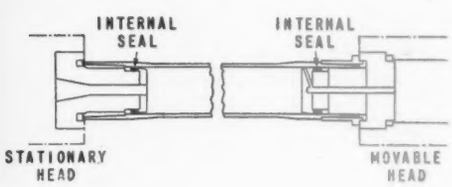


FIG. 15. High pressure test bench.



Recapitulation

1. *Field Method of Testing (Fig. 1)*
   Advantages:
   a. Inexpensive equipment.
   b. Portable. Can be set up anywhere.
   c. No inherent limitations on pressure.
   d. Both pipe and coupling are tested.
   e. Coupling thread leaks easy to see.
   f. No compressive (buckling) force on pipe.
   Disadvantages:
   a. Very slow. Not applicable to mill production.
   b. Testing in tension may mask borderline defects.
   c. Rather dangerous to personnel, either from bursting of pipe or connections blowing off.
2. *Testing between Heads (Fig. 5)*
   Advantages:
   a. Very fast. Can keep up with mill production.
   b. Both pipe and coupling are tested.
   c. Testing in compression aggravates borderline defects.
   d. Coupling thread leaks fairly easy to see.
   e. No danger from failure of connections.
   Disadvantages:
   a. Testing pressures limited to about 3000 to 5000 psi.
   b. Couplings may be distorted.
   c. Pipe is in some compression and must be retained.
   d. Not portable. Mill use only.
3. *Testing with External Rubber Seals (Fig. 8)*
   Advantages:
   a. Can test up to 10,000 psi or more.
   b. Testing in compression aggravates borderline defects.
   c. No danger to personnel.
   d. Reasonable rate of production.
   e. Reasonable cost per test.
   Disadvantages:
   a. Quite expensive on account of high investment cost.
   b. Pipe is in very heavy compression and must be retained.
   c. Not portable.
4. *Testing with Internal Rubber Seals (Fig. 15)*
   Advantages:
   a. Can test up to 10,000 psi or more.
   b. Tests pipe in neither tension nor compression.
   c. No danger to personnel.
   d. Reasonable rate of production.
   e. Reasonable cost per test.
   Disadvantages:
   a. Quite expensive on account of high investment cost.
   b. Pipe is subject to buckling and must be retained.
   c. Not portable.

As to whether inside or outside rubber flanges are used is a matter of expediency. Thus, inside packing cannot pack off on the inside of a coupling; therefore, only the outside sealing can be used on threaded and coupled material. With certain integral joint products inside packing is more advantageous, and with plain end tubes either method is satisfactory from a theoretical standpoint. Practically, the outside packing is more acceptable because a tube has greater inside dimension variations than the outside.

Conclusions

All things considered, it is the author's opinion that the most satisfactory methods of internally high pressure testing oil country tubular material is by the last two methods described: Testing with external or internal rubber flanges. In these methods the advantages greatly outweigh the rather minor disadvantages. This is especially true when considering the needs and wishes of the user. In other words, *they most fully protect the oil producing company against defective tubes.*

The next best method is the first one described: "Field Method of Testing (Fig. 1)." In fact, it is the only method, available today, in the oil fields. At least it has the one great advantage of simplicity.

References

1. "Internal Hydrostatic Pressure Testing as a Measure of the Performance Values of Casing and Tubing" by H. G. Texter, Third World Petroleum Congress, The Hague, 1951.
2. "Leak Resistance of Casing Joints in Ten-

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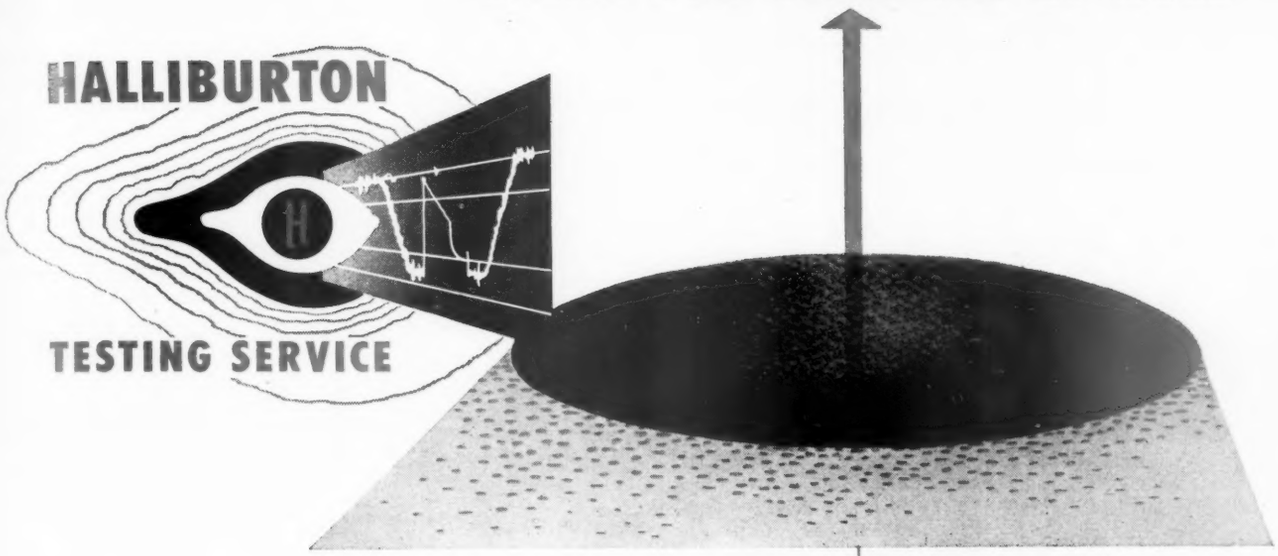

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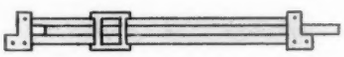

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sion" by P. D. Thomas and A. W. Bartok, Page 243 API Drilling and Production Practice—1941.
3. "A Theoretical and Experimental Approach to the Problem of Collapse of Deep-Well Casing" by J. L. Holmquist and A. Nadai, Page 392 API Drilling and Production Practice—1939.
4. Lubinski's letter, Appendix B.
5. "Influence of Tension and Compression on Straightness and Buckling of Tubular Goods in Oil Wells" by Arthur Lubinski, presented before Subcommittee on Pipe Research, 31st annual meeting of API, Chicago, November 5, 1951.

APPENDIX A

The usual form of Barlow's formula, for calculating internal pressures for tubular sections, is:

$P = \frac{2St}{D}$ in which:

P = Internal pressure in psi

S = Yield strength (hoop stress) of the material, in psi

t = Wall thickness in inches

D = Outside diameter of the tube, in inches.

Then, for example, the yield point pressure of 7-in. OD, 29-lb, N-80 (80,000 psi minimum yield strength) casing (with a wall thickness of .408 in.) would be:

$$P = \frac{2 \times 80{,}000 \times .408}{7} = 9326 \text{ psi}$$

Then, for the API alternative pressure test figure = 80 per cent of 9326 = 7461 (Published as 7500 psi).

To obtain hoop stress from a given internal pressure the formula, of course, reads:

$$S = \frac{PD}{2t}$$

Unfortunately Barlow's formula is only an approximation, which is quite sufficient for thin wall tubes, but gives too large an error when applied to heavy wall or walled casing and tubing. Fortunately the error is on the safe side in calculating allowable pressures or when calculating hoop stress imposed by a given pressure.

Actually, the hoop stress is not constant throughout the cross section, but is the largest at the inner surface. The actual hoop stress, S_a, at the inner surface may be obtained with the well known thick cylinder formula:

$$S_a = \frac{R^2 + 1}{R^2 - 1} P, \text{ in which}$$

$R = \frac{OD}{ID}$ (Outside diameter divided by inside diameter).

P = Internal pressure in psi.

Again considering 7-in. OD, 29-lb, N-80 casing:

$$R = \frac{7}{6.184} = 1.132$$

P = 7500 psi.

Then:

$$S_a = \frac{1.132^2 + 1}{1.132^2 - 1} \times 7500 = 60{,}800 \text{ psi.}$$

Corresponding value obtained with Barlow's formula is:

$$S_b = \frac{PD}{2t} = \frac{7500 \times 7}{2 \times 0.408} = 64{,}300 \text{ psi.}$$

Consequently, when subjecting the casing to a stress calculated by Barlow's formula, as equal to 80 per cent of the minimum yield strength, the actual stress at the inner surface is equal to:

$\frac{60{,}800}{64{,}300} \times 80 =$ only 75.6 per cent.

Obviously, the heavier the wall thickness the greater the error of Barlow's formula.

APPENDIX B

Letter from A. Lubinski to H. G. Texter dated September 25, 1951.

... At the last API Standardization Meeting in Denver (May 1951), it was reported that, in some cases, lengths of casing subjected to internal pressure tests have buckled. Later, you asked me for an explanation of this phenomenon and means for calculating and preventing it. This letter provides you with the answers.

Imagine the test as shown schematically in Fig. 1. The length of pipe J is held in two seals or packings P, located at the ends of the outside surface of the pipe. These packings provide pressure-proof connections between the pipe J and the chambers A and B. The pressure is applied through tubing T.

The longitudinal thrust applied on the annular edges of the pipe by the

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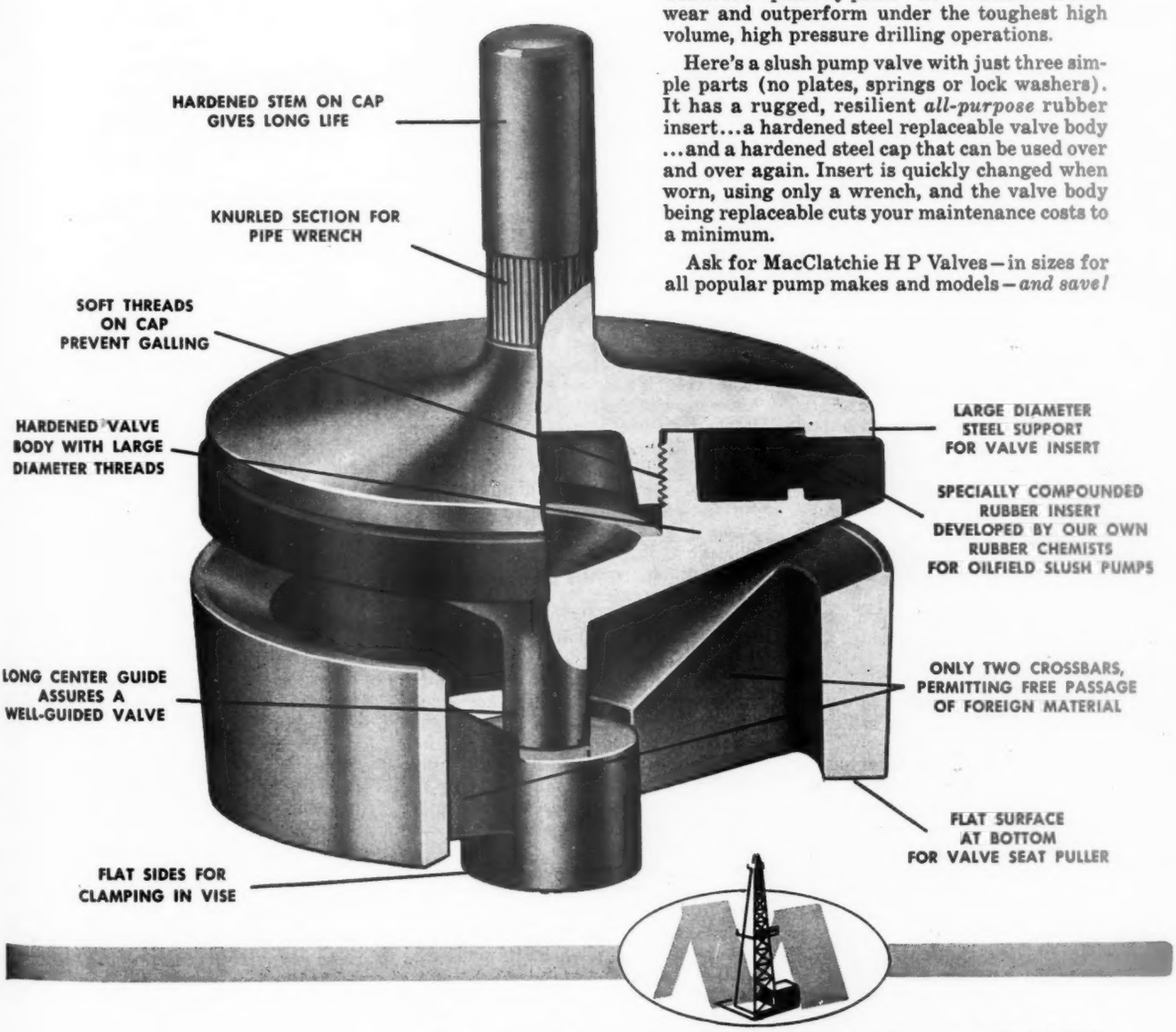
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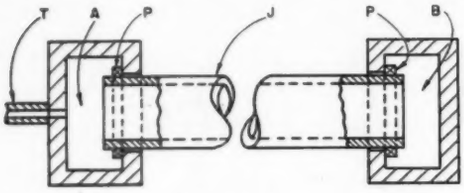

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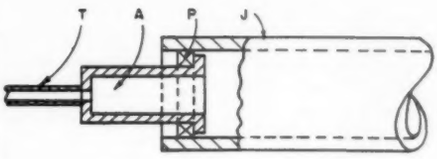

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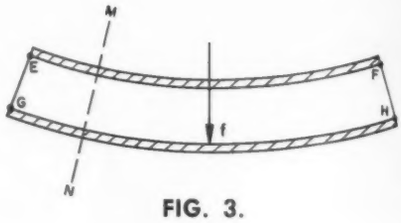

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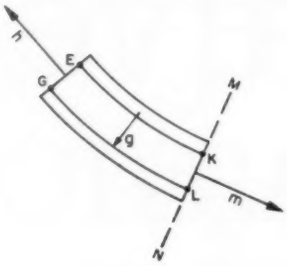

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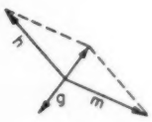

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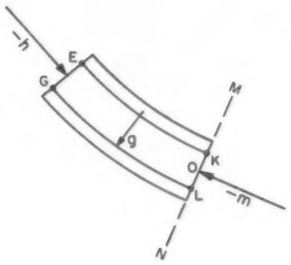

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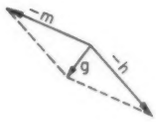


FIG. 7.

hydraulic pressure is not large enough to buckle the pipe. In order to explain the phenomenon, consider first the case with internal seals and no longitudinal thrust at all as shown in Fig. 2.

Imagine that the length of pipe has been bent by a lateral force, which is then removed. If the pipe comes back to the straight form, there is no buckling. On the other hand, buckling occurs if the deflection of the pipe increases until a bent form of equilibrium is reached.

As long as the pipe is straight, the resultant of pressure forces acting on the pipe is obviously nil. On the other hand, as soon as there is a deflection, this resultant is no longer nil, because the arc GH (see Fig. 3) is longer than the arc EF and, consequently, this resultant is directed as shown by f in Fig. 3. Common sense indicates that the force f has a tendency to buckle the pipe, and buckling will actually occur if f is large enough, i.e., if either the internal pressure or the length of pipe is large enough.

The fact that a pipe may buckle when subjected to an internal pressure and no compression has been demonstrated by an ingenious experiment made by Mr. H. B. Woods when presenting a discussion to Klinkenberg's paper in Beaumont, Texas, last spring.

In order to analyze the problem quantitatively, imagine any cross section MN (Fig. 3) in the pipe and consider the forces acting on the portion of the pipe located to the left of MN (Fig. 4). If EKLG were an enclosed chamber, then the resultant of pressure forces acting on this chamber would be nil* and the pressure forces would be as follows:

1. The force h acting on the end EG.
2. The force m acting on the end KL.
3. The force g acting on the internal lateral surface. As explained above for the whole length, g is not nil, because the pipe is bent and the arc GL is longer than the arc EK.

*Actually, this resultant would be equal to the weight of the fluid, but in the case of a single length, this weight is so small compared to the pressure forces that it may be neglected.

The fact that the resultant of the forces g, h, and m is nil may be expressed in other words as follows: The force g is equal in magnitude to the resultant of the forces h and m (see Fig. 5) but opposite in direction; or, otherwise, the force g is equal to the resultant of the forces –h and –m (see Figs. 6 and 7).

Actually, the chamber EKLG is not enclosed but open at the ends EG and KL, and the forces h and m do not exist. The previous reasoning shows, however, why the resultant g of pressure forces acting on the portion of the pipe located to the left of MN has the same effect on this portion as the forces –h and –m. We may then eliminate from our consideration the force g and replace it by –h and –m. The bending moment at the cross section of MN is, by definition, equal to the sum of moments with respect to the center O of the forces acting on the portion of the pipe located to the left of the cross section MN. As the force –m passes through O, the moment of this force with respect to O is nil and, consequently, the bending moment at MN is equal only to the moment of the force –h with respect to O. –h is, of course, equal to the pressure multiplied by the internal cross-section area of the pipe. Thus, the two following important conclusions are drawn:

1. Using internal seals and applying an internal pressure to a length of pipe open at both ends has the same effect on buckling as compressing the length by two forces applied at its ends and equal to the product of the internal pressure in psi and the cross-sectional area in square inches corresponding to ID.

2. If the internal pressure is large enough, the pipe buckles without being under compression.

Consider now the case of the external seal (Fig. 1). The difference between this case and the preceding one is that besides the same moment as previously, i.e., the moment with respect to the point O of the force -h, we must also consider the moment of pressure forces actually acting on the edges and equal to the product of the internal pressure and the wall cross-sectional area. The sum of -h and the force on an edge is equal to the product of pressure and the cross-sectional area corresponding to OD. Thus, the following two conclusions are drawn:

1. Using external seals and applying an internal pressure to a length of pipe open at both ends has the same effect on buckling as compressing the length by two forces applied at its ends and equal to the product of the internal pressure in psi by the cross-sectional area in sq. in corresponding to OD.

2. If the internal pressure is large enough, the pipe buckles under much less compression than would be needed under actual column loading.

3. Critical conditions, that is to say, the minimum pressure for which a length buckles or the minimum length for which a pipe buckles when subjected to a given pressure, may be calculated with conventional buckling formulae or various end conditions. In these formulae, the longitudinal force must be replaced by the product of the pressure and the cross-sectional area corresponding to OD.

If the pipe buckles when subjected to an internal high pressure test, then the simple means of preventing it is to increase the number of intermediary supports. It is probably necessary that these supports hold the pipe all the way around but not necessarily very tightly. I think that a small play between the supports and the pipe would be harmless, because the only reason for supporting the pipe above is to limit buckling deflections to small harmless values. ★ ★ ★

How to Calculate Relative Permeability of Bradford Sand from Capillary Pressure Data

Engineers require data that will permit them to interpret behavior of a reservoir in order to have greater operational efficiency

M. E. HASSAN and R. F. NIELSEN

An equation was derived for calculating permeability from capillary pressure-saturation data for Bradford sand. The analogy between the porous medium and a bundle of capillary tubes constitutes the basis of this method. To correct for the difference between the length of the fluid path and length of the core the "cementation factor" as empirically defined for Bradford sand was used. The relative permeability curve for the Bradford sand was calculated using average values of the $J(S_w)$ *function.*

Introduction

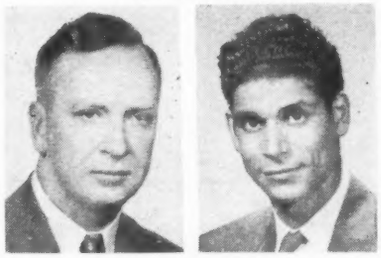
DIFFICULTIES encountered in measuring relative permeabilities of cores have shown a need for seeking a relation between these and some other physical property defining the porous medium.

Recently Ritter and Drake[11,12] realized the necessity of the assumption of simple shapes in order that capillary pressure data may yield information concerning pore size distribution and fluid flow in the porous medium. Assuming the pores to be cylinders and that the flowing fluid obeys Poiseuille's Law, Childs and George[1] showed that relative water permeability could be calculated from the capillary pressure-water saturation curve. Other investigators[9] have also given equations relating the permeability of a porous medium to the capillary pressure curve by assuming the porous medium to be analogous to a bundle of capillary tubes. Gates and Lietz[3] derived an equation from Purcell's equation to calculate relative permeability. Fatt and Dykstra,[2] assuming that the core sample can be represented by a bundle of capillary tubes, gave an equation to calculate the relative water permeability as a function of water saturation. It was also assumed in their derivation of this equation that the fluid path length varies with saturation. In the present paper, the ratio of the fluid path length to the bulk length is considered to vary with both saturation and porosity.

Theory

Considering a bundle of N capillary tubes, the flow through a differential number dN will be

The Authors



R. F. Nielsen M. E. Hassan

R. F. Nielsen is associate professor of petroleum and natural gas engineering, Pennsylvania State College. Recipient of a PhD degree from the University of Nebraska, Nielsen was a research chemist for U. S. Rubber Company, instructor at Kansas State College, and research engineer at Stanolind Oil and Gas Company.

M. E. Hassan, a native of Cairo, Egypt, is now completing work for his PhD degree in petroleum and natural gas at Pennsylvania State College. He was graduated from Fouad 1st University of Egypt in 1947, and worked as resident engineer for the Egyptian Government in RasGharib and Hurghada Oilfields, Eastern Desert of Egypt. He received his MSc degree from the University of Texas, and later worked as trainee with Eastman Oil Well Survey Company in the Gulf of Mexico and the West Coast areas.

$$dQ = q_{av.}\,dN$$

Poiseuille's Law governing the flow of fluid can be applied as long as dN is small, in which case

$$q_{av.} = \frac{\pi r^4 \Delta p}{8\mu l}$$

$$dQ = \frac{\pi r^4 \Delta p}{8\mu l}\,dN$$

The change in volume dV will be equal to $\pi r^2 l dN$. As the saturation of a core is equal to the ratio of the volume of the saturating fluid to that of the pore volume

$$\text{i.e., } S_w = \frac{V}{V_p} = \frac{V}{A\varphi L}$$

$$dV = \varphi A L dS_w$$

it follows that

$$dQ = \frac{r^2 \Delta p A \varphi L}{8\mu l^2}\,dS_w \quad . \quad . \quad (1)$$

Darcy's Law states that

$$Q = \frac{KA\Delta p}{\mu L}$$

thus differentiating gives

$$dQ = \frac{A\Delta p}{\mu L}\,dK \quad . \quad . \quad (2)$$

From Equations (1) and (2), it follows that

$$\frac{A\Delta p}{\mu L}\,dK = \frac{r^2 \Delta p A \varphi L}{8\mu l^2}\,dS_w$$

or

$$dK = \frac{r^2 \varphi L^2}{8 l^2} \quad . \quad . \quad . \quad (3)$$

where $\frac{l^2}{L^2} = t$ is the tortuosity factor.

It has been found experimentally[8] that

$$m = 1 - \frac{\ln T}{\ln S_w} \quad . \quad . \quad . \quad (4)$$

where T, the tortuosity factor, was defined to correct the resistivity values from the case of a bundle of capillary tubes to the case of the porous medium.

In the case of fluid flow t is approximately the same at T, and is assumed equal to it for the case considered here.

Accordingly, equation (4) gives

$$t = (S_w \varphi)^{1-m} \quad . \quad . \quad (5)$$

From the definition of capillary pressure in the case of a capillary tube

$$r = \frac{2\delta \cos\Theta}{P_c} \quad . \quad . \quad . \quad (6)$$

Using the "J" function developed by Leverett[7] and given by

$$P_c = \delta \cos\Theta\, J(S_w) \left(\frac{K_a}{\varphi}\right)^{1/2} \quad . \quad . \quad . \quad (7)$$

$$r = \frac{2}{J(S_w)\left(\frac{K_a}{\varphi}\right)^{1/2}} \quad . \quad . \quad . \quad (8)$$

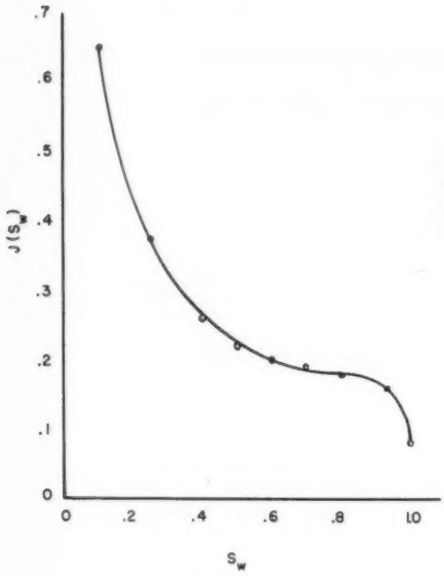


FIG. 1.

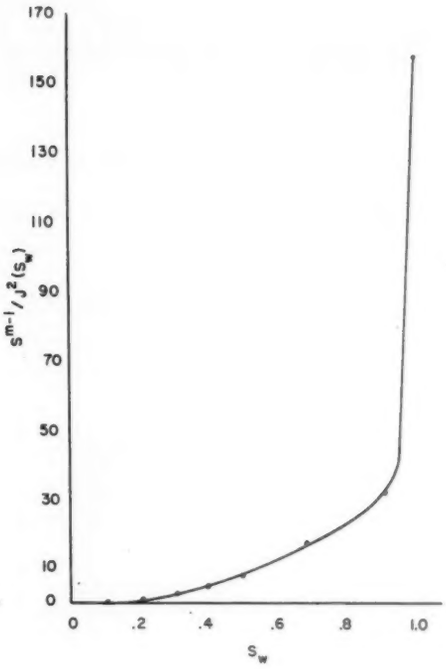


FIG. 2.

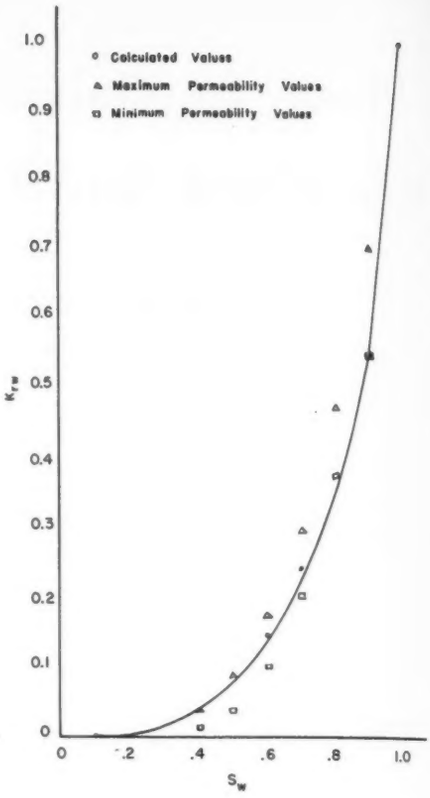


FIG. 3.

Substituting (5) and (8) in (3) we get

$$dK = \frac{4\varphi}{8\left(\frac{K_a}{\varphi}\right)J^2(S_w)}$$

$$(S_w\varphi)^{m-1}\,dS_w = \frac{\varphi^{m+1}}{2K_a}\,\frac{S_w^{m-1}}{J^2(S_w)}\,dS_w$$

$$K_e = \frac{\varphi^{m+1}}{2K_a}\int_0^S \frac{S_w^{m-1}}{J^2(S_w)}\,dS_w$$

Thus relative permeability will be given by

$$\frac{\displaystyle\int_0^S \frac{S_w^{m-1}}{J^2(S_w)}\,dS_w}{\displaystyle\int_0^{100} \frac{S_w^{m-1}}{J^2(S_w)}\,dS_w}$$

Calculations

This method was applied to the calculation of wetting phase relative permeability from the $J(S_w)$ data for Bradford cores using the data of the mean curve of Kinney, Killins, and Nielsen.[5]

The cementation factor "m" for Bradford was taken as given by the equation

$$m = 2.5 - 2\varphi^{(4)}$$

Table 1 shows the calculated data. Fig. 1 is a reproduction of the mean curve given in Kinney's Thesis for a limiting wetting phase saturation of 20 per cent. Fig. 2 gives the relation between $\frac{S_w^{m-1}}{J^2(S_w)}$ and S_w, while Fig. 3 gives the calculated values for relative permeability "K_{rw}" against wetting phase saturation "S_w". On the same graph is plotted the maximum and minimum relative permeability values from the Rapoport and Leas method as calculated by Kinney et al from the mean $J(S_w)$ curve.

It appears that the curve calculated by the present method is between the minimum and maximum curves of the Rapoport and Leas method. At high wetting phase saturation there is good agreement with the Rapoport and Leas minimum curve and at low wetting phase saturation there is good agreement with the Rapoport and Leas maximum curve.

S_w	S_w^{m-1}	$J(S_w)$	$J^2(S_w)$	$\frac{S_w^{m-1}}{J^2(S_w)}$	$\frac{S_w^{m-1}}{J^2(S_w)}$	K_{rw}
1.00	1.00	0.08	0.0064	156.25	14.8	1
0.9	0.875	0.17	0.0289	30.28	8.15	0.550
0.8	0.745	0.18	0.0325	22.92	5.55	0.375
0.7	0.627	0.19	0.0360	17.42	3.60	0.243
0.6	0.515	0.20	0.0400	12.87	2.15	0.145
0.5	0.407	0.22	0.0484	8.41	1.05	0.071
0.4	0.302	0.26	0.0676	4.47	0.65	0.044
0.3	0.208	0.33	0.1089	1.91	0.30	0.019
0.2	0.123	0.44	0.1936	0.64	0.05	0.002
0.1	0.05	0.65	0.4225	0.12	0	0
0.0	0	—	—	0	0	0

Notations Used

- φ fraction per cent of porosity
- m cementation factor
- S_w saturation per cent of wetting phase
- K_a specific permeability to air
- V_p pore volume
- P_c capillary pressure
- δ interfacial tension
- Θ contact angle
- K_{rw} relative permeability to the wetting phase
- l fluid path
- L length of the core
- μ viscosity

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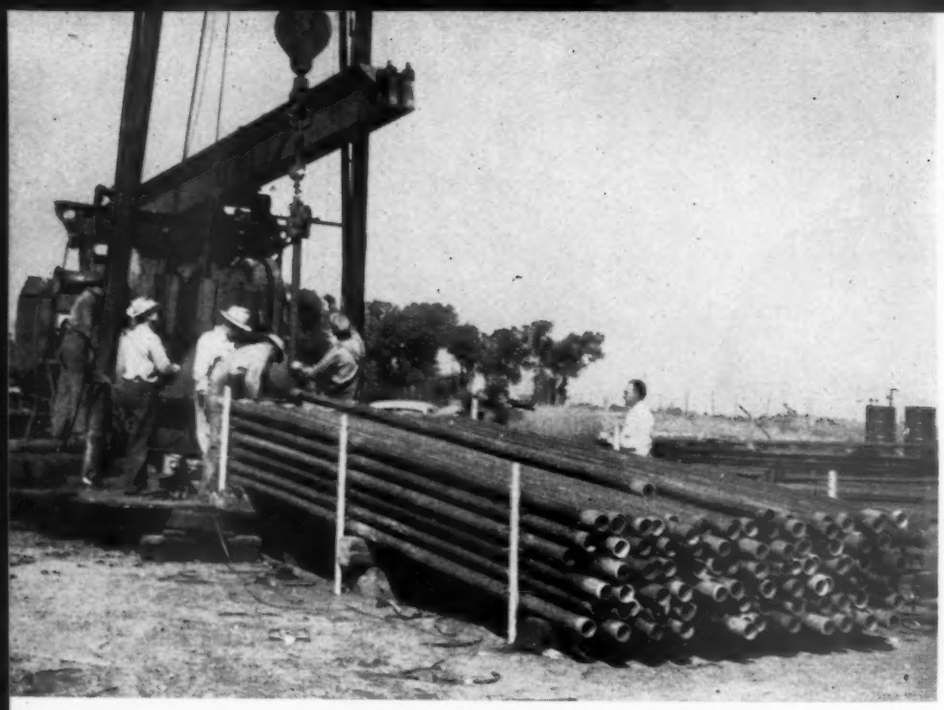


Installation of Fibercast is made with a standard set of small elevators. A four-man crew handled the tubing with a tailing-in unit — three on the derrick floor and one on the stabbing board. F. E. Pollard, far left, was tool-pusher. (SWD Grosshardt No. 2, Claflin, Kansas.)

Resin Tubing Used for Salt Water Disposal

In order to prevent corrosion to the casing a protective oil blanket is incorporated in the method

T. DENIS GARDNER*

On September 4 and 5, 1952, another string of a new kind of thermosetting resin pipe,* was added to the list of successful salt water disposal well installations in central Kansas.

The National Co-operative Refinery Association with headquarters in Wichita, Kansas, installed the 3½-in. OD (3-in ID) tubing in their SWD Grosshardt No. 2, in the NW¼ of Section 4, R 17 S, T 11 W, Barton County, six miles north and one mile west of Claflin.

This particular well, which is in the Kraft-Prussa pool, had been drilled in November, 1949, through the Arbuckle formation (top of which lies at about 3350 ft in this area) to a depth of 3534 ft, or below the sand which is about 70 ft thick. Its 5½-in. 15-lb casing had been set at 3400 ft with 75 sacks of cement, leaving 134 ft of open hole below the casing. The oil well was abandoned, however, and was later used as a salt water disposal well, together with a second similar well in the area. The oil company members of the salt water disposal association had built a battery of tanks to collect salt water from 87 producing oil wells in the pool. The disposal well took care of 200 bbl per hour (or 4800 bbl per day) of salt water that were injected into it from the tanks.

Corroded-out steel casing and tubing had to be replaced twice, and so this time when the tubing failed, it was decided to install the special resin type tubing. This type of tubing in disposal wells was successfully installed and operated initially by the Superior Oil Company in a 3495-ft well in Jennings, Louisiana, in May of this year.

J. W. Rockhold, petroleum engineer for the National Co-operative Refinery Association, was in direct charge of the installation at the Claflin well. Gage Lee, general superintendent of production and drilling from their Wichita office; C. E. Heilman, production superintendent out of their Great Bend office; and Harvey Kates, assistant production superintendent out of their Hitchman field office, were also present during the installation proceedings.

Gordon Jones of the Rice Engineering Company, Chase, Kansas, specialists in salt water disposal systems, was on hand as consulting engineer. Also as a courtesy, the manufacturers sent up from their plant Jerry Hutchison, sales engineer who is familiar with all the specifications of the pipe, and from first-hand experience, could lend assistance or advice on its proper handling.

Instead of running a packer down and sealing it at the bottom of the casing as was done in Louisiana, the engineers recommended running and hanging the tubing with only a thread protector at its open end.

The length of tubing string preferably is run at least to the depth of the casing to be protected from salt water corrosion (in this well 3400 ft) and if it extends a little below, so much the better. Then the tubing and the casing annulus is filled with oil, naphtha, or third grade gasoline to seal off the casing and to more or less steady the tubing in the hole.

The day before the installation, on September 3, the hole was acidized with 2000 gal of 30 per cent acid and swabbed for several hours. The actual installation of the tubing was begun at 9:40 A.M., September 4, 1952, with an Association roustabout crew (F. E. Pollard toolpusher) and a tailing-in unit.

A standard set of two small elevators was used to install the tubing. Slips that ordinarily are used with heavy steel tubing are not used with this special tubing, as they could possibly collapse the plastic. The first joint, which was run with only a thread-protector on bottom, was pulled forward from the top of the rack by one man of the crew, as a 20-ft length of pipe weighs only about 40 lb. The second man on the derrick floor slipped the first elevator around the tubing just below its collar. The elevator with the pipe was raised by the power unit until its length swung free from the rack and just above the casing head. The two men then guided it into the hole, as it was lowered by the elevator, while a third man on the stabbing board was able to steady its upper end with only one hand.

When the length was in the hole and the elevator had come to rest on the casing head at derrick floor level, one man applied a special graphite base lubricant to the inside threads of the collar while the other man attached the second elevator to lift the next joint of tubing. The lubricant was then applied to the outside threads of that hanging end, and the two men stabbed the joint. They then screwed the joint by hand to about half-way up the threads, and used a special friction-type wrench* to complete the turns.

This process was repeated until the four-man crew had put down 171 twenty-foot lengths without any difficulties. Short pieces of plastic protectors had been screwed into each threaded end by the makers, so that all pieces were easily assembled, and none had to be

*Fibercast, manufactured by Perrault Brothers, Sandsprings, Oklahoma.

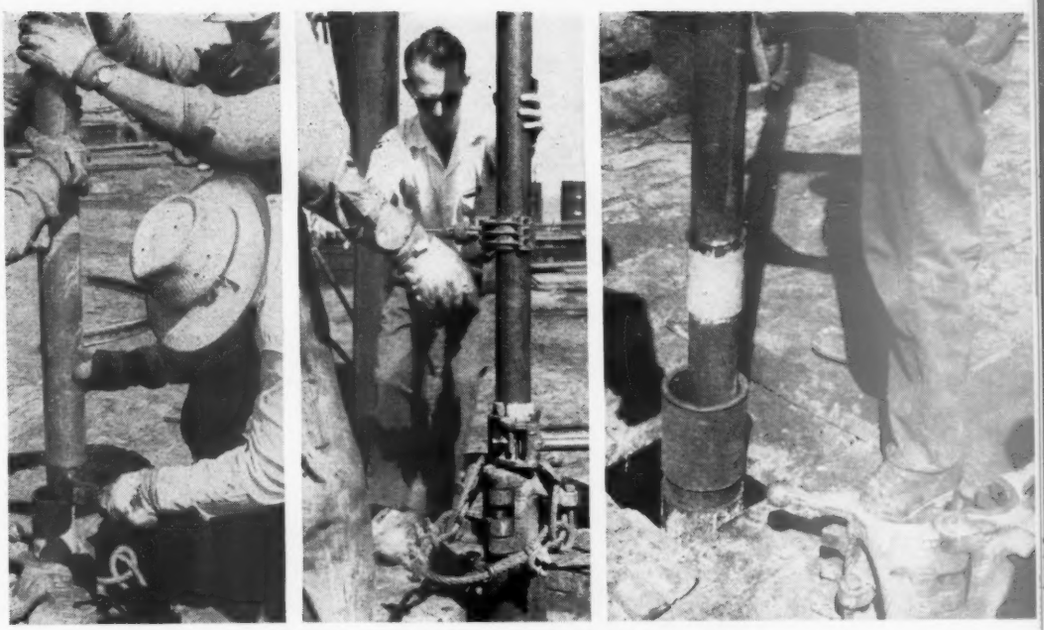
*Parmalee

EXCLUSIVE

Graphite base lubricant is also applied to threads of second joint with the paint brush before it is stabbed in.

Center, special friction type Parmalee wrenches are used to complete the joint. Though Fibercast withstands an external pressure of 500 psi, slips ordinarily used with steel tubing could possibly collapse the resin pipe.

Far right, the last sealed joint of Fibercast resin tubing goes down into well through the casing-head, and will be "hung by its ears" so to speak from a tubing-head. (All three photos made at Grosshardt No. 2, Claflin, Kansas.)



rejected. A special weldfast cement was used to seal the top thread of a three-foot pup joint, which was screwed into the mandril of a standard type tubing head. The installation was completed at 11:30 A.M., September 5, after eight hours actual running time. The men did not work a night shift.

The normal procedure of tallying was followed as each rack of joints was run. The tally at the well indicated the bottom of the tubing to be at 3406.8 ft from the derrick floor, from which all measurements were taken. A tubing finder run on a wire line as a check showed the bottom to be 3406 ft. The NCRA engineers plan to check the bottom of the tubing again within 90 days to see if there has been any parting or elongation.

The same day, a wire line was run down into the tubing and showed the static water level to be 1125 ft. Previous checks had given approximately the same figure.

As both the Rice Engineering Company and Perrault Brothers engineers had successfully used crude oil and naphtha respectively in other salt water disposal wells, they had first thought to use one or the other again. It was decided in this instance, however, to use third grade gasoline as the cost was less and differences in densities—and any hazards that might be involved—were negligible.

With a specific gravity of 0.73, this gasoline is equivalent to approximately 61-deg oil. Its purpose is to lubricate the casing and prevent its contact with corrosive salt water.

The static fluid level of the water in the tubing was 1125 ft below the derrick floor, which meant that a 2275 ft column of water was standing in the well. The hydrostatic figure of 2275 multiplied by the weight per foot of head of Arbuckle salt water (in this instance 0.442) gave approximately 1000 psi bottom hole pressure (at 3400 ft). The 1000 psi divided by the weight per foot of head of third grade gasoline (0.316) meant about 3170 ft of gasoline would be required in the annulus. As the volume of the annulus was 0.0119 bbl per linear foot, 38 bbl of gasoline was required to give the same bottom hole pressure as the salt water gave in the tubing. The calculated quantity of gasoline would fill the tubing-casing annulus to 230 ft below the derrick floor. (See Fig. 1.) The 38 bbl of gasoline were then injected into the tubing-casing annulus.

A pressure gage was installed at the top of the annulus for the purpose of keeping a constant check on the pressures from day to day. As water is injected into the well, the gasoline level will attempt to rise an amount equal to the weight of the column of water above static level in the tubing, minus friction loss through the tubing. According to the engineers, the gasoline will never go into the formation below the casing at 3400 ft because it is balanced with an equal weight of water in the tubing, and it cannot escape at the surface because the tubing is packed off from the casing in the head.

In the aforementioned first installation in the Louisiana well, fresh water was pumped into the annulus above a packer to prevent salt-water corrosion of the casing. Rice Engineering Company has found the oil or gasoline method to be better, not only because it makes the installation process simpler and easier, but because if any trouble does develop—which they hasten to add is very improbable—the tubing could be more easily removed.

The resin tubing is alleged to be inert to most all chemical substances such as oil and gas and their products, salt solutions, acids, alkalis, and sulfur such as are found in oil fields. If no other chemical is present to cause deterioration or corrosion, the resin pipe should last indefinitely.

The product first came onto the industrial market in January of last year after two years of extensive development work in a half-million dollar plant built by Perrault Brothers. This particular plastic tubing is made by two polyester resins blended together, with catalyst and dyes added, for making thermoset-

Fibercast installation supervisory personnel, left to right: Gordon Jones of Rice Engineering Company; J. W. Rockhold, of NCRA; Jerry Hutchinson of Perrault Brothers; and Gage Lee, General Superintendent with NCRA, out of Wichita office, at site of SWD Grosshardt No. 2, Claflin, Kansas.

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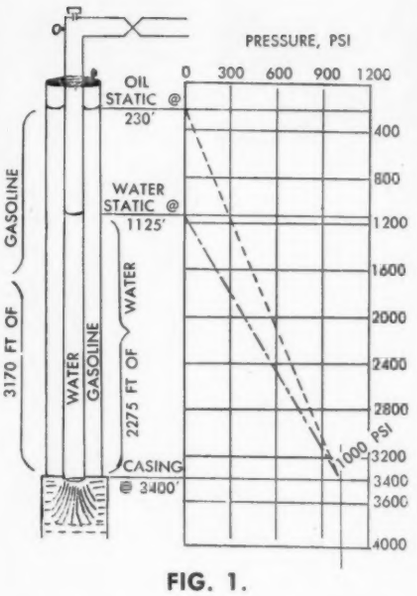

FIG. 1.

ting plastic stable at temperatures between –65 and 300 F. The pipe will not melt or distort in ordinary temperature ranges as most kinds of thermoplastics do. It will disintegrate, however, in temperatures over 300 deg.

Glass fibers are incorporated into the tubing in alternating layers to give it tensile strength and resistence to burst and collapse pressures. The tubing used in the Kansas wells is capable of withstanding an internal pressure of 300 psi, and external pressure of 500 psi, and a tensile strength of 10,000 lb in laboratory tests. The makers recommend no more than 7000 lb of tension to be put on an assembly of joints, collars, threads, and glue. The string of 171 joints in the Claflin well weighed 6840 lb (40 lb to the 20-ft length) in air, but due to bouyancy of the water, the actual pull on the top joint is only about 3840 lb.

Previous successful installations in salt water disposal wells were made by The Texas Company at Claflin, Kansas, with a string 3394 ft long, and by the Continental Oil Company at Genesco, Kansas, with a string 3293 ft long—both done this summer.

Several other oil companies are using the pipe for salt water disposal surface lines. To name a few, Anderson-Prichard Oil Corporation and the Atlantic Refining Company are each using it in oil fields near Great Bend, Kansas. The Superior Oil Company has applied it in a field near Sinton, Texas, and Davison Brothers of Robinson, Illinois, are using it in their state—all with apparent satisfaction. * * *

☆ ☆ ☆

Exploitation Control

As a measure of controlling exploitation of boring permits over sizable acreage, Mines Minister Philip T. Kelly and the Ontario Government has announced that an Order-in-Council has been passed requiring oil men to deposit a $25 bond per square mile for boring rights in the Province. These bonds will permit exploration and prospecting for oil.

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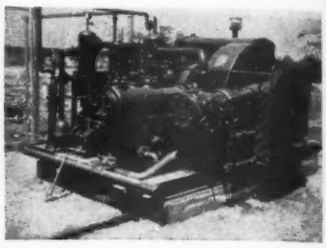

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FIG. 1. These marine fossils are associated with ancient reef deposits and are useful in reconstructing the manner in which the reef was formed.

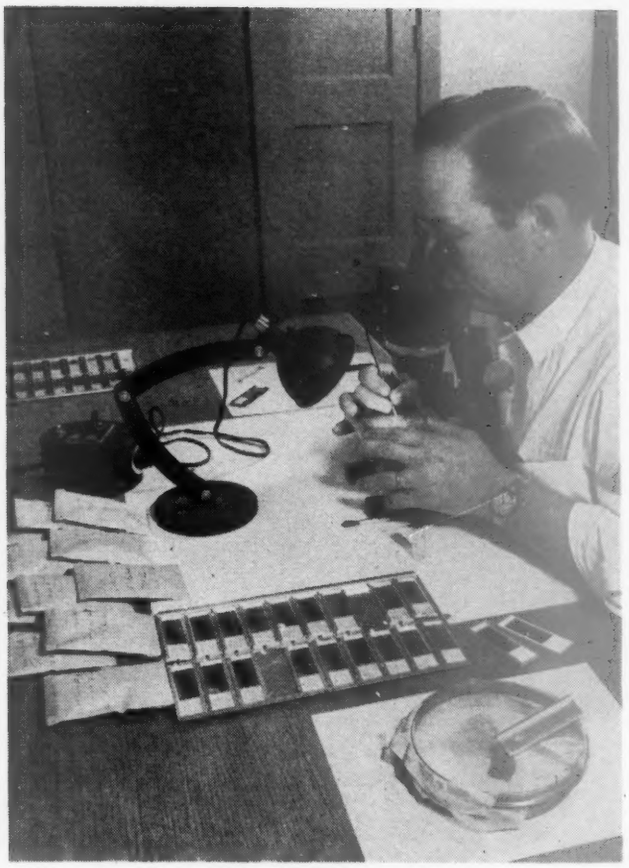


FIG. 2. A geologist examines sediments for microscopic fossil content in conjunction with research on reef origin.

Oil Discovery and Recovery Methods Advance

Magnolia Field Research Laboratories investigate recent deposits in Gulf of Mexico for better understanding of oil formation characteristics of the dim past

JACK MENNEER*

LEGEND has it that in the "good old days" many a well site was chosen at random. Stories are told how a hat would be thrown to the wind and the spot where the hat landed was the new wildcat location.

Whether true or false, such romantic tales are a far cry from the modern methods of locating oil fields. In addition, techniques in the drilling for, and the recovery of oil have also advanced to a high degree. Although great strides have been made in the fields of exploration, and drilling and producing, oil companies continue to appropriate vast sums of money to oil research.

Laboratory research is directed toward improvement in techniques and equipment. On the average the industry finds today that 80 per cent of wildcat wells are dry and to reduce the chances of drilling a dry hole is an obvious aim of research. Drilling costs have been mounting rapidly and it is believed that research in this field can obtain substantial savings. Moreover, despite the application of the best engineering know-how an operator is still forced to leave a large fraction of discovered oil in the ground at the abandonment stage. Consequently, research on better methods of oil recovery earnestly is sought.

A glimpse at the Magnolia Field Research Laboratories, Dallas, Texas, reveals the magnitude and diversification of investigations that are aimed at these objectives. The organization of such a center reflects the importance that management attaches to research.

Projects conducted are for the Socony-Vacuum Oil Company group, of which Magnolia and General Petroleum are affiliates, and includes the new Pegasus division with headquarters at Billings, Montana. Over 300 people are employed at the laboratories. The work covers long range research and technical service; the latter concerns problems by assignment from the field operational departments. The larger function of the laboratories in research and the technical service group helps to bridge the gap between research and field operations by making available to the field operations many highly specialized techniques.

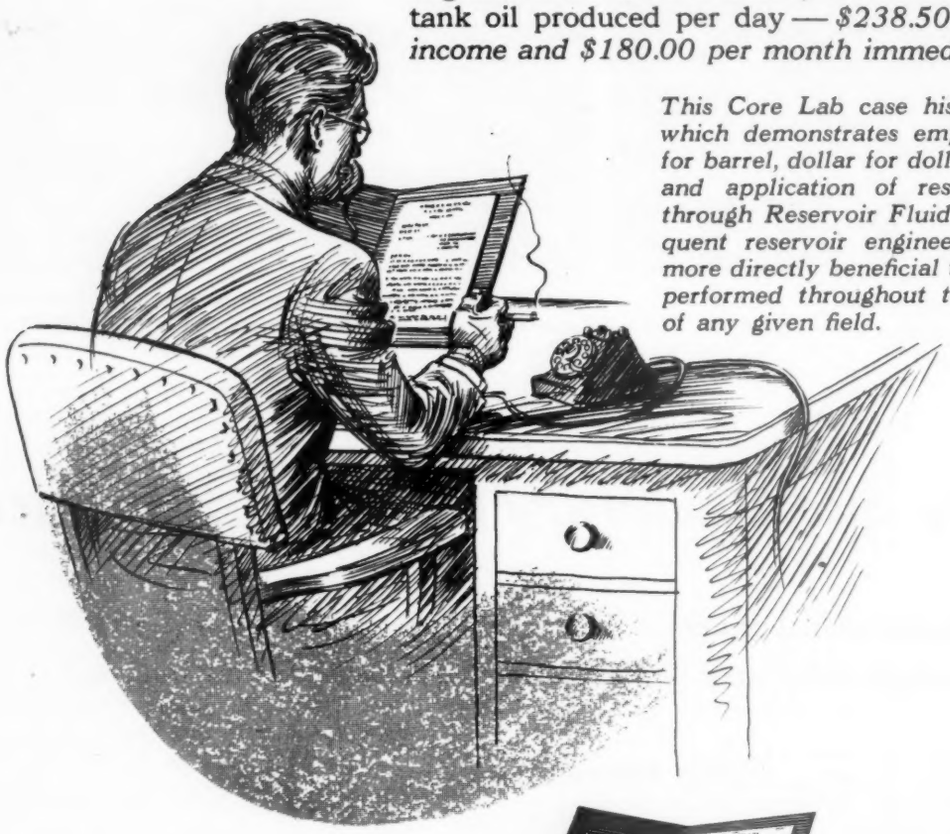
The studies and problems range from

*Editor, Drilling and Producing.

EXCLUSIVE

He made this new discovery without drilling a single well...

Shrinkage factor data presented in a Core Lab *Reservoir Fluid Analysis Report* indicated that, after separator pressure was increased from 35 psig to 110 psig, about 3 percent more stock tank oil was recovered per unit volume of reservoir oil produced; and that stock tank oil gravity was increased from slightly less than 38 degrees API to over 40 degrees API. The net result, based on 100 barrels of stock tank oil produced per day — *$238.50 per month deferred income and $180.00 per month immediate income.*



This Core Lab case history is one of many which demonstrates emphatically that barrel for barrel, dollar for dollar, the comprehension and application of reservoir data obtained through Reservoir Fluid Analysis (and subsequent reservoir engineering studies) can be more directly beneficial than any other service performed throughout the productive history of any given field.

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CORE LAB

PETROLEUM RESERVOIR ENGINEERING

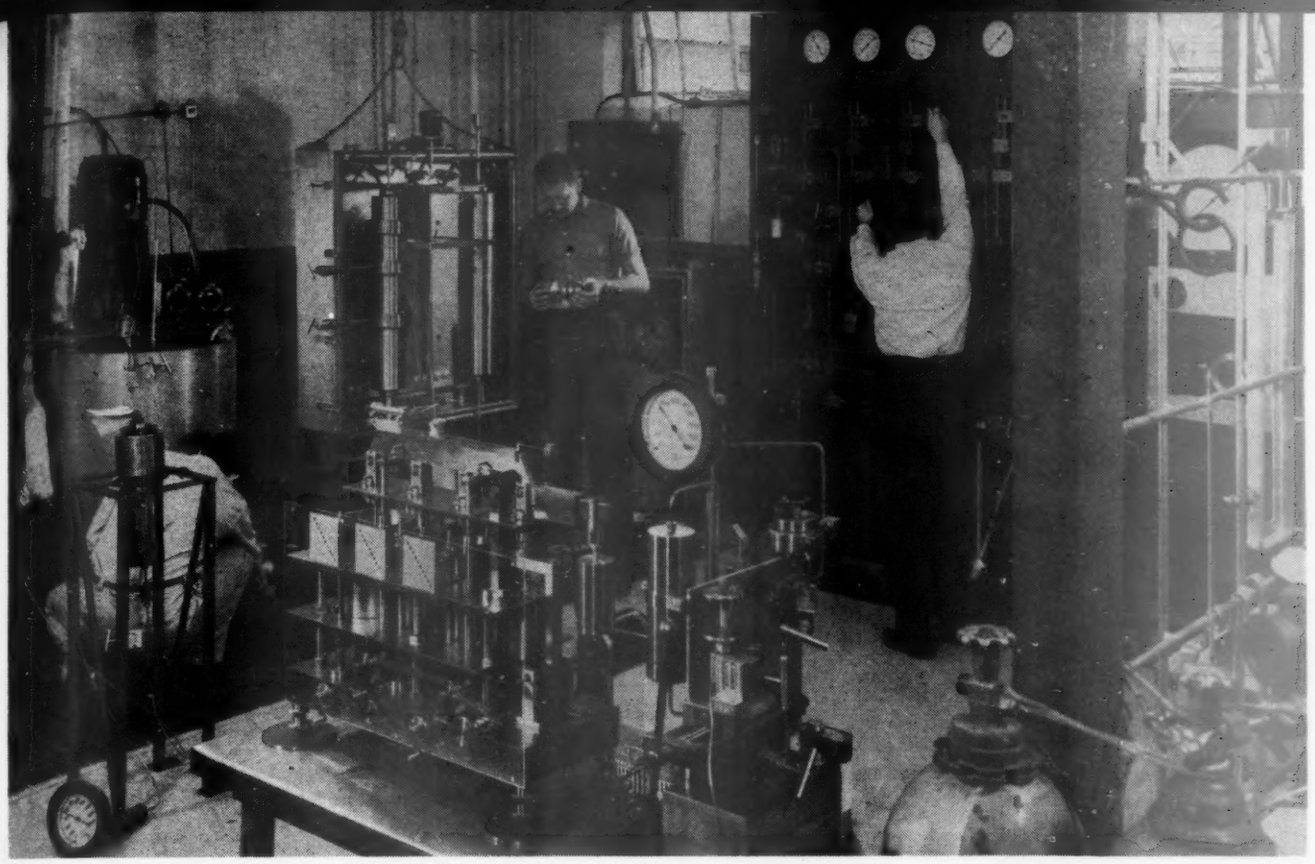

FIG. 3. General view of the PVT and Technical Service Laboratory. Foreground is the sensitive pressure balance. Background (left) is the high pressure-temperature PVT cell. Background (right) is a pressure manifold system.

a local to a general nature. The research and technical service deals with group operations on a world wide basis. A problem say in Canada or Venezuela or the Middle East or the U. S. A. is likely to be considered. A long list would be necessary to describe all the phases of work done at the laboratories. A short summary includes the following. In exploration there is geology, geochemistry, geophysics, seismic, and well logging. In production there is drilling muds, cements, reservoir mechanics, fluid behavior and instruments, secondary recovery, and corrosion. A brief description is given on these various subjects.

Exploration Research

The basis of the geological research is to study the fundamental mechanisms of how and where oil is formed, how reservoirs are formed, and how oil migrates into the reservoir. A key to the solution of determining oil possibilities is found in the study of recent deposits so that a better evaluation of the past may be obtained, and deposition in the Gulf of Mexico is studied with great interest. These recent deposits are throwing much light on the subject of oil generation and it may be possible to learn much about the Gulf Coast stratigraphy, and the conditions necessary to form the anomalous stratigraphic oil trap may be better understood.

For determining the age of recent or-

FIG. 4. Mathematical analysis shows that many of the waves resulting from a seismic explosion are related to the detailed elastic properties of shallow formations.

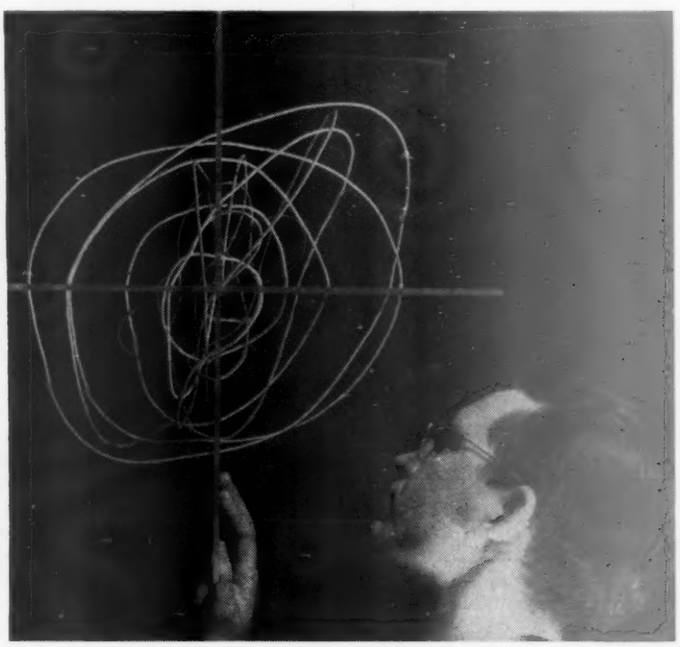

FIG. 5. A dynamite explosion as used in seismic prospecting causes an earth particle to follow a trajectory shown in this enlarged three dimensional plot.

FIG. 6. Acoustic logging tool is being lowered into a well in North East Texas.

FIG. 7. Various type logs can be run in the field with this equipment that is mounted in a special truck.

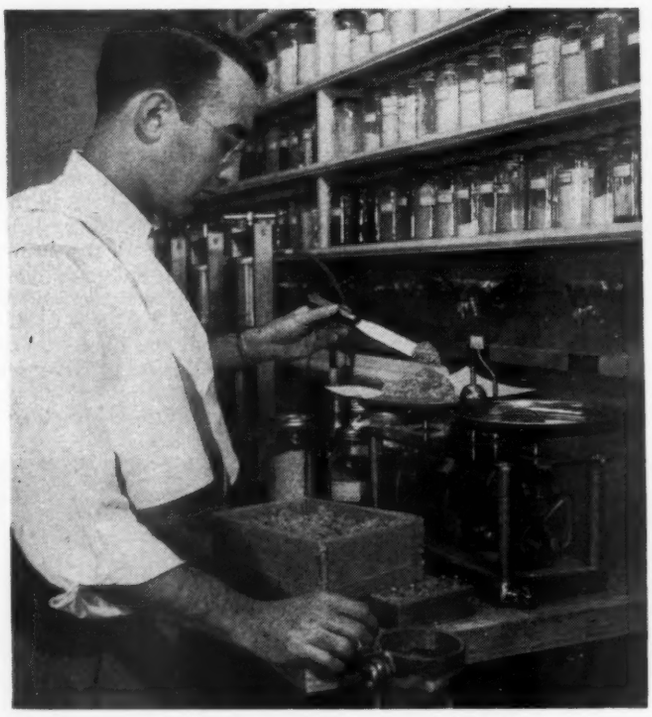

FIG. 8. A sample of fibrous leather is weighed for a test of drilling fluid designed in the laboratory for correcting lost circulation.

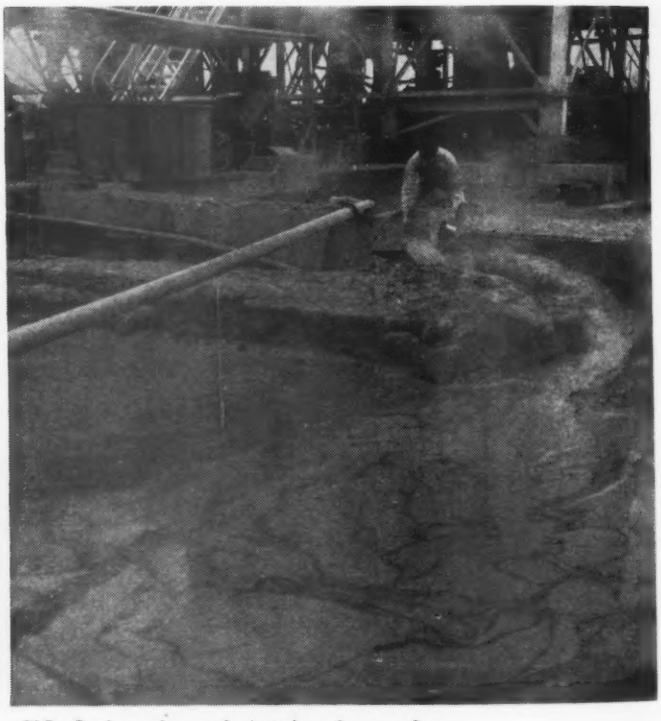

FIG. 9. A mud sample is taken from a flow line for testing at the Dallas laboratory.

ganic deposits the Carbon 14 method is employed. Because the carbon in material derived from living organisms loses half its radio activity each succeeding 5600 years it is possible to find the age of a sample not in excess of 25,000 years and to within an accuracy of a few hundred years.

The detection of infinitely small quantities of petroleum in sedimentary and recent deposits comes under geochemical analysis. The origin and composition of organic material is considered. For example, studies are made with an infrared spectograph to analyze the type and structure of the components of a petroleum crude. This instrument is sensitive to 20 parts per million and can be used for detecting the minute presence of oil in say a core sample. It is also applicable for differentiating between various types of crude, which is particularly important when attempting to decide if wells are multi-zoned or not.

The main objective of the geophysical research is to develop better physical instruments and techniques in exploring for oil.

An important seismic tool was developed at the Magnolia Field Research Laboratories, and it is designed to measure the compressional velocity throughout the borehole. Reflection horizons can be interpreted from the velocity curve and the method is rapid. Two men take 2 hours to do a job that would require 18 men 22 hours by the geophone system.

Seismic research is progressing along the lines of recording seismic surveys in a reproducible form by using a magnetic tape recording. It is hoped that this technique will allow the computer a greater flexibility in the interpretation of the survey records. The designed equipment is particularly useful in ar-

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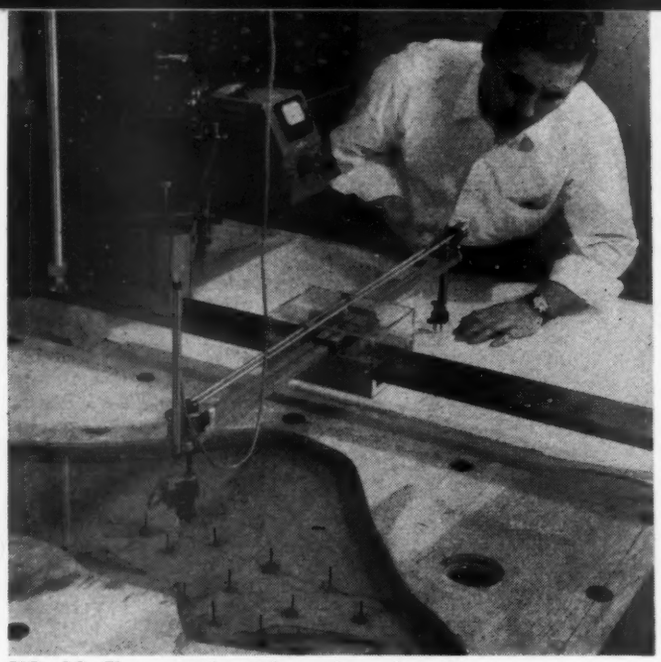


FIG. 10. The potentiometric analyzer in water flood and gas injection projects. It is also used as an anologue computer in certain research problems.

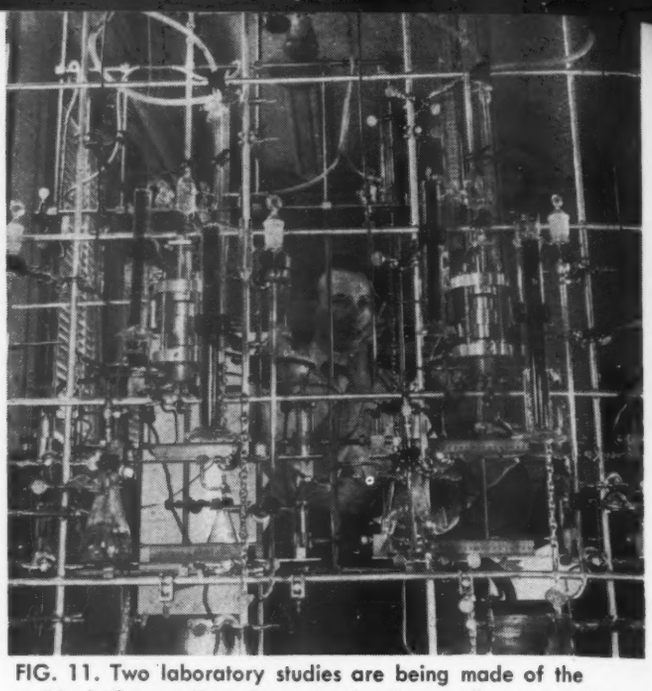
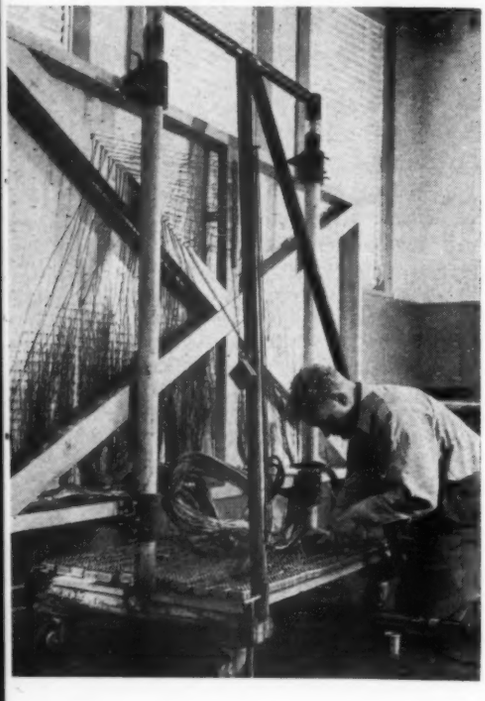


FIG. 11. Two laboratory studies are being made of the residual oil saturation after water flooding small core samples.

riving at standardized procedures for a new area.

Another new well-logging device has also come from the Research Laboratories. The instrument was originally intended to supplement magnetometer surveys because it would measure the magnetic properties of earth formations and reveal which formations influence the magnetometer survey. Another application for actual oil field operations is associated with the possibility of adding a magnetic tracer to the well fluids (drilling muds or injected fluids) and of ascertaining with the logging instrument distribution of fluids in the well. This procedure has experienced some success in Hydrafraced wells.

FIG. 12. Rear view of a reservoir model that is used with the unsteady state reservoir analyzer.



Production Research

Many factors enter into the successful and efficient development and producing program for a field or reservoir. Take for example the drilling fluid. Here the requirements are for the formulation of a circulating medium that has the least detrimental effect upon a formation. Filter loss properties of fluids are investigated for the possibility of reducing pay zone damage by filtrate invasion. Much consideration is given to the minimizing of "hole problems" that may occur during the drilling. As a result of past studies, field test procedures are now performed so that high temperature stability can prevail without gelation when using lime base drilling fluids. The maximum benefit from electric logging without mud invasion interference is a problem that is studied.

Lost circulation is a hazard to the operator and the Laboratories have applied a fibrous leather substance[1] to combatting the trouble. The product has been used extensively and successfully in West Texas. Also, a special time-setting clay cement[2] and the technique for applying it to severe lost circulation zones has been developed, and it has proved quite successful in the Gulf Coast area. The effects of acidizing a limestone pay zone and any new methods that will stimulate production constantly are under review.

Corrosion plays a destructive role that can be a prominent one in some oil fields. Investigations are conducted toward the establishing of factors that cause corrosion and methods that can prevent its commencement.

Reservoir mechanics is studied with the view to have a high or higher percentage recovery. Some factors that influence recovery are permeability, porosity, static behavior of fluids, and capillarity. Future behavior of a producing reservoir can be forecast in a relatively short time by supplying the electric analogue computer with sufficient past history field data. The analysis considers the unsteady state approach to the problem, and the machine is essentially a special electrical computer. Another means is the use of an electric potentiometric model that imitates by electrical impulses specific operational conditions, for example, rate of production or injection, etc. The potentiometric method is useful for determining probable water flood patterns or desired rates of injection.

Production will vary in accordance with pressure, volume, and temperature changes. Samples of crude are tested and are studied under simulated reservoir and separator conditions. From these determinations improvement in field producing operations may be warranted.

Technical Service

A very important consideration in any research program is that the results of the research are utilized in the company's commercial operations. The Magnolia Field Research Laboratories have established a technical service group to facilitate this application, and particularly its production research results. Specific problems in drilling muds, corrosion, reservoir behavior, and crude oil characteristics are submitted to this group from the global operations of Socony and its affiliates.

The specialized equipment and techniques, such as the reservoir analyzers, which have been developed by research are then applied to the specific problem. In this manner the findings of the laboratory research have immediate application in the field with a minimum of interference with the progress toward the overall research objectives.

The winning of oil requires much technical and scientific knowledge. Advancements are sought continuously to improve the present practices. Without the assistance of research the discovery and recovery of oil would be jeopardized.

* * *

[1]Trade name Leather Floc.
[2]Trade name Formaplug.

a well-side chat

about "permanent" installations of

BAKER RETAINER PRODUCTION PACKERS

(SETTING) *Melvin Matthews, Baker Branch Manager, chats with an operator in the Magnolia Field in Southern Arkansas, who has a number of wells ready to go on the pump.*

(TIME) *December, 1952.*

Operator: What experience have you had with Baker Packers in *this* field?

Matthews: Well, we just finished setting a Baker Packer in *this* well.

Operator: What do you mean? This well has been on production for ten years.

Matthews: You're right. A Baker Model "B" Packer was run in on tubing and set in December, 1942. At that time the well had a bottom-hole pressure of 3,750 psi.

Operator: You mean the packer has been in all that time and held up for ten years?

Matthews: That's right, for 10 years. You know Baker claims that their packers are for "permanent" installations, and I guess when a packer stands up for ten years with that differential across it that's "permanent" enough, and mighty good performance.

Operator: Sure sounds "permanent" enough for me. By the way, how many Baker Packers are in this field anyway?

Matthews: Well, I don't know exactly how many were set to start with, but there are 31 I can think of right off hand that were set in 1942 and are still operating perfectly.

Operator: Man, that's a lot of packers in one field like this. Will the new packer you just set in this well be good for another ten years?

Matthews: It will probably be good for 20 years, because it was the new "D-4" packer, and they should easily last twice as long.

Operator: What makes you think that?

Matthews: Well, there are a number of reasons. In the first place the packers set here in 1942 had the seal in the packer and it couldn't be repaired. With the new "D-4" the seals are on the Tubing Seal Nipple which is part of the tubing string, and when the seals need repairing you just pull the tubing, install new seals on the Baker Tubing Seal Nipple and run in again.

Operator: That sounds like a real improvement.

Matthews: Yes, it was, but that's just part of it. With wells getting deeper and both pressures and temperatures higher, the new Baker Packers have lead seals to back up the resilient packing element, and then we put in malleable iron rings to back up the lead seals. Our Engineering Department found that when things got really tough the resilient packing element wouldn't stand up by itself, and even the lead would give way sometimes under extreme conditions. So, we backed up the lead with malleable iron rings—and believe me, that did it.

Operator: Sounds like you *could* be right about that new packer lasting 20 years. But what about drilling out the packer if you have to go on the pump?

Matthews: No trouble at all. The new packer is just as drillable as the old type was, and operators around here know that *it* drills up easily because they've had to drill 'em when the wells finally quit and had to be put on the pump.

Operator: Well, I guess you're right about "permanent" installations. If a packer holds out until the well quits and you have to put her on the pump, that should be "permanent" enough to satisfy anybody.

■

The Baker Retainer Production Packer has so many other advantages besides being "permanent" that you ought to know all about it. You should know how it can be set on a wire line (as well as on tubing or drill pipe)—how it virtually becomes part of the casing, leaving the tubing free to be run or pulled as often as necessary—how you can produce two zones separately and simultaneously.

There's a new issue of Baker Equipment News on the subject of "Dual Zone Completion Practices" which is well worth your study. Ask any Baker representative or office for your copy.

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Problems in Producing and Gathering Low Pressure Gas

Cooperation between plant and production department yields results

CARL L. RITTER*

This article is unusual and timely because the problems confronting both the plant and production divisions are discussed. In addition, closer cooperation between these two departments can lead to the elimination of existing problems.

Modern practices in the gathering of low pressure gas are given.

In order that a system may function efficiently, close liaison should be maintained in all departments.

The article is a condensation of the paper that was presented to the Natural Gasoline Association of America.

GASOLINE plant operations are not limited to the confines of the plant fence, but stretch out to the farthest source of gas upon which the plant is dependent. For no matter how well designed and equipped the plant may be, it cannot produce a single drop of gasoline or LPG products until there is a flow of gas through it.

The first requisite of a low pressure gas gathering system is to have some low pressure gas to gather and the plant is dependent upon the producer for gas to process. The production and delivery of gas to the plant is of prime importance, and factors affecting this production and delivery concern plant operators as well as the producer.

Producing problems are many and are of grave concern to the producer even though, at times, a plant operator may feel that all they do is open up a flow bean on a well and "let her go". This type of feeling reaches a climax when the plant is operating smoothly and suddenly without any warning, there is a large increase in gas load and instantly a flood of crude oil accompanying the gas reaches the plant.

Production Problems

The producer is faced with many problems, some of which are spacing, completion and recompletion of wells, flow rates, allowables, gas injection, testing, conservation, separator and battery installations, flow lines, treating problems, handling and disposition of salt water, corrosion, et cetera. The problems encountered will vary from field to field and—at times—from well to well. Each problem must be studied by the producer and his staff, and a decision made that will bring about the most efficient operation and greatest return on investment. Nearly every one of the producer's problems has a direct bearing on our problems, and the decisions they make can materially affect the installation and operation of a gas gathering system.

Paraffin accumulation in the tubing of oil wells and flow lines can cause the producer considerable trouble and expense. This problem is prevalent in both warm and cold climates, being aggravated during periods of cold weather. Various paraffin solvents have been used, as well as the application of heat and mechanical scrapers to try to reduce this trouble.

At the present time, there are several ways to control paraffin, but probably the most common are to install tubing that has been coated inside with a plastic and flow lines of plastic or plastic-coated pipe. Results from the use of plastic in this type of service have been very encouraging to date.

The production of salt water is a never-ending problem. Sometimes it is possible to recomplete the well, thus reducing the volume of salt water. In some cases it is advantageous to resort to a water injection program, thus returning the salt water to the producing formation. In other cases it is necessary to dispose of the salt water in other formations. In either case the producer is faced with providing pumps, flow lines, separators, treaters, and other facilities to handle the salt water and to provide means of combating corrosion.

The problem of oil and/or salt water carryover from separators or heater treaters is a constant source of friction between the oil or gas producer and plant personnel. This problem is acute in areas of flush production, areas with high paraffin content in oils, and in areas in the final depletion stage where it is necessary to produce a large volume of salt water with a very few barrels of oil.

All too often separators, flow lines, and dump valves are sized to operate at lower flow rates and at higher pressures than are actually used. Use of manufacturers' ratings can be misleading, as such ratings are based on steady flow. If consideration is given to peak rates of flow and expected minimum operating pressures in sizing the equipment to be installed, the problem of separator carryover would be greatly minimized.

Not all the blame for separator carryover can be placed upon the producer because, in a great many cases, it is due to the failure of the back pressure regulator to seat properly. As, in nearly every case, the back pressure regulator is installed and maintained by the gasoline plant personnel, the correction of this problem is up to them.

Batteries and Gathering Systems

In cold climates, the design of batteries and gathering systems should be coordinated to provide shelter and heat for separator controls, wet gas regulators, and relief valves. Batteries are now designed and built using oil treaters (instead of boilers) with the result that no steam is available to combat freezing troubles. It is possible that some type of portable steam generator could be obtained that would remove the temptation for employees to use an open flame to thaw regulators, and lines in hazardous locations. Injections of hot calcium chloride water is a method used in some locations, but this has obvious drawbacks. Constant surveillance of equipment and close cooperation between the producer and the plant personnel are necessary in preventing many of these troubles.

It is possible to reduce separator carryover by raising the pressure on the separator, however, the pressure carried on the separator can materially affect the gpm of the gas going to the plant. Figs. 1 and 2 show gross and net gpm's at various operating pressures. These data were obtained by compression tests of gas from two different formations in the same field.

The curve for Formation "A" shows that any increase in separator pressure from zero pounds to 30 lb will materially affect the gpm of the gas. The separator pressure could be raised from 30 lb to 55 lb with very little affect on the gpm.

Curve for Formation "B" (Fig. 2) shows that any increase in separator pressure from zero pounds to 55 lb will have a marked affect on the gpm of the gas.

It is sometimes hard to convince a producer that he should use the minimum separator pressure necessary to dump the oil. Sometimes a decrease of 3 to 5 lb on a separator will give an increase of ½ gal of gasoline per 1000 cu ft; but as any one producer may sell only a small portion of the plant's overall volume, his monetary gain is small and may not offset possible operating troubles that the lower pressure might cause. On the other hand, when the same half gallon increase in gpm is applied against the total plant volume of say 20,000 MCF a day, it means an increase in production of 10,000 gal per day. At a price of five cents per gallon, this amounts to $500 per day; therefore, there is a selling job to do. This job should become easier because of the increase in market price of gas and prod-

*Assistant director, natural gasoline and gas operations — production department, Continental Oil Company.

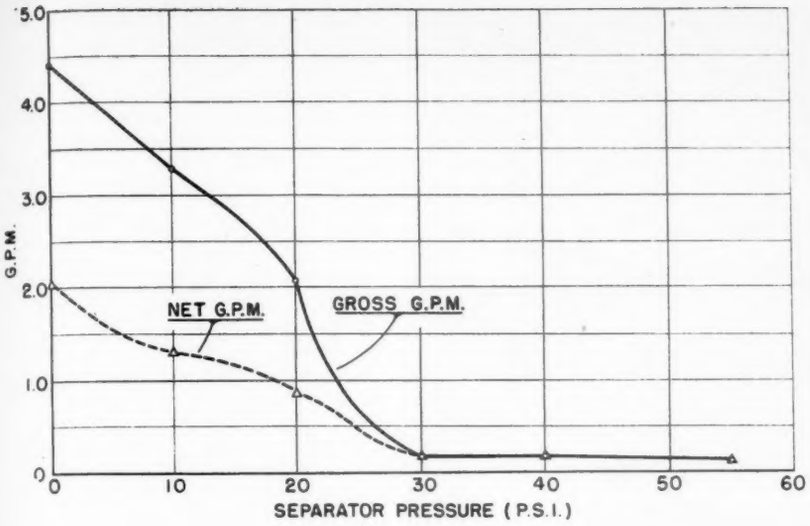

FIG. 1. Gross and net gallons per minute by compression tests—Formation A.

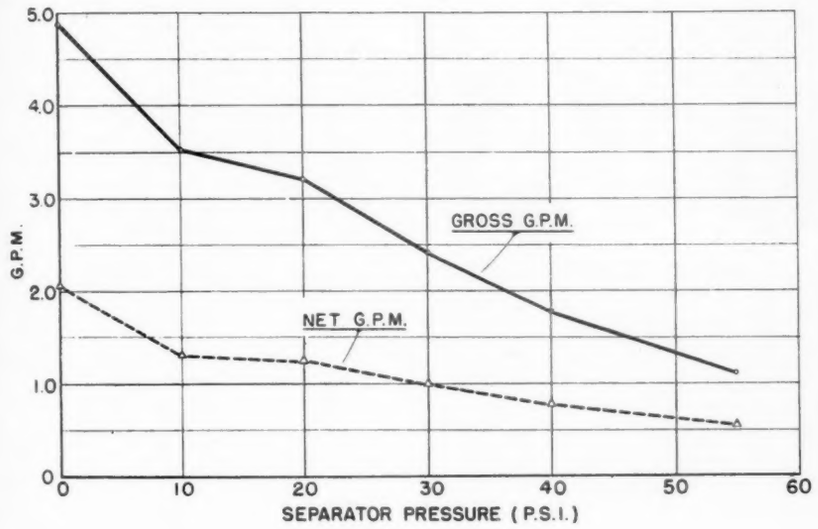

FIG. 2. Gross and net gallons per minute by compression tests—Formation B.

ucts, and, also, because the producer in many cases owns a prorata share of any new plants being installed. Thus, the producer stands to gain not just from his lease but, also, from his ownership in the plant. For maximum benefits to both producers and plant owners, the separator pressure should be set to best meet the overall requirements of lease and plant.

Meters

Many additional books could be written on metering problems and still they would not have all the answers. Certainly many have participated in discussions concerning horizontal meter runs versus vertical meter runs.

The company has encountered more freezing trouble using the vertical meter run than when using the horizontal. Our vertical meter runs fill meter and gage lines with condensate and water much more readily than our horizontal runs. Certain plant gas is metered through horizontal runs with very little trouble. The same gas is measured through vertical runs, and water in the gage lines causes considerable meter maintenance.

On some of these vertical meter runs condensate traps 30 in. in length fabricated from 2-in. pipe have been installed. This type of trap has been installed by piping out of the flange taps down into the side of the trap, then, pipe from the top of the trap with a valve to the meter. No valve is installed between the flange tap and the condensate pot. This type of installation has reduced freezing troubles.

Where possible on horizontal runs equipped with orifice fittings, the orifice fitting is laid on its side so that the flange taps are in a vertical position. Then, by using ½-in. piping it is possible to reduce the freezing troubles considerably, as any condensation or free liquid that gets into the lines will tend to gravitate back into the meter run before it reaches the meter mercury chamber.

The installation of mercury or con-

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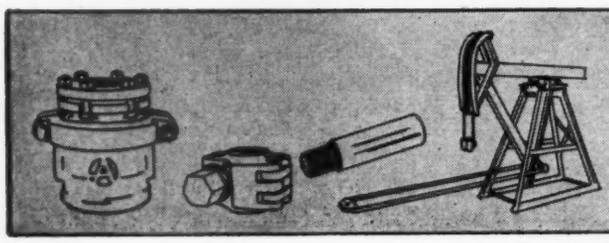

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Problems of metering gas where pulsation is present are of grave concern, and make it difficult when trying to correlate the volume shown by a master meter with the total volume shown by several meters. The results are sometimes "yes" and sometimes "no".

At times orifice plates, or some other way of choking the flow, have been used to eliminate the effect of pulsation. To effect a large pressure drop between the meter run and compressors, and thus cause an increase in velocity, will help in a great many cases. Generally, every increase in pressure drop means the installation of additional horsepower.

Snubbers

Several pulsation snubbers have been put on the market. Some recommend the installation of a snubber on each compressor, while others recommend that the snubber be installed on the main suction line or main discharge line from a group of compressors.

The company has had no experience with the use of a snubber on each compressor; however, a snubber was installed on the main discharge line from a group of compressors in two different areas. The results obtained have been very good. One of these snubbers may be installed in the near future on the main suction line to a group of compressors.

In order to cut down on the effect of pulsation, the master meters and pressure control regulators in a few cases were installed ahead of the first stage suction scrubbers. Results to date indicate improvements, but are still not too satisfactory. Fig. 3 compares the gas measurement by master meters with those of field meters in one of the plants where there is this type of installation. This chart uses field meter volumes as base measurement. From November 1945, until March 1950, there were two master meters and 18 lease meters in service. Since March 1950, there have been 3 master meters and 29 to 30 lease meters in service. It can be seen that there has been quite a variation from month to month. This is an illustration of the trouble experienced in trying to balance volumes by field meters with those of master meters. In some instances, there is very little difference by months between the master meters and the lease meters, but at other times they show anywhere from 6.2 per cent less gas to 6.2 per cent more gas.

The dotted line on the chart shows the per cent variation by yearly periods. While this variation has changed from year to year, there was only one year when the difference has been slightly above 3 per cent. That was in 1948 when the master meter showed 3.055 per cent less gas than was shown by the total of the lease meters for the year. The variation for the yearly periods is still not too bad, but then again there is room for improvement. It might be of interest to mention that from November 1945, through February 1952, the total volume

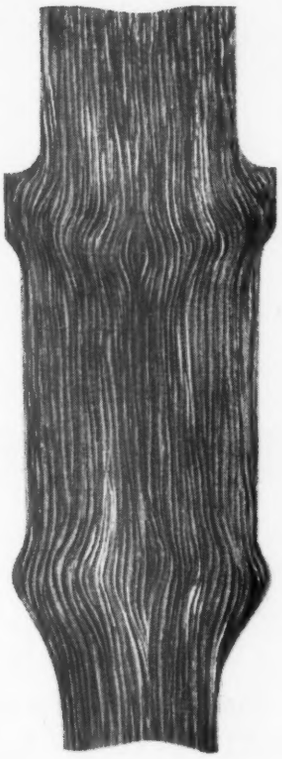

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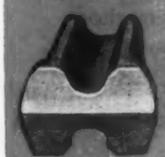
Fig. 108AA Acme Alloy Drillmaz Bit



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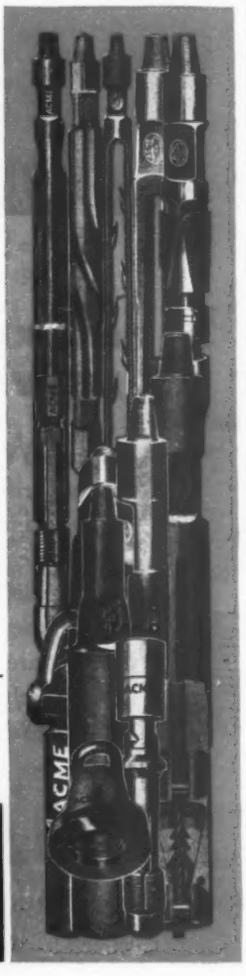

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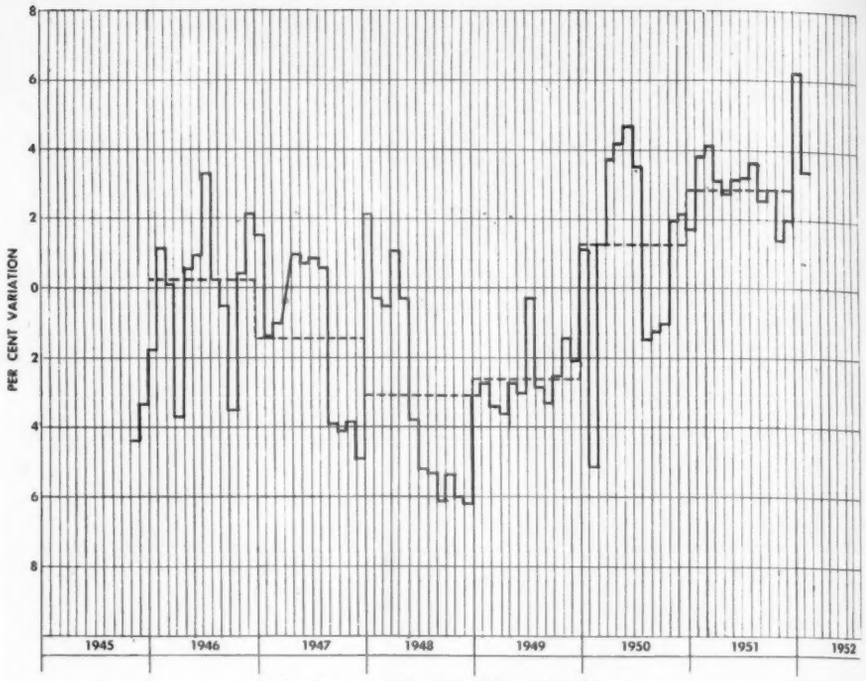

Daily Average Base Volumes by Year

Year	MCF	Year	MCF	Year	MCF
1946	11,489	1948	12,943	1950	15,341
1947	11,775	1949	12,411	1951	19,080

FIG. 3. Comparison of measurements—master meter vs field meters.

shown by the master meters was .038 of one per cent less gas than was shown by the total of the lease meters. The total volume of gas measured during that period was approximately 32 billion cu ft. It will be interesting to know what the per cent variation will be at the end of another year or two's operation if it follows the trend that is now apparent.

It has not been possible to account for the variations shown in Fig. 3. There appears to be a tendency for the measurements to cycle with seasons of the year or with settlement test periods, but this proves to be an illusion when examined closely.

Gas-Lift

Probably one of the biggest headaches in metering is encountered with gas-lift gas. As an example the following data were taken from a chart of a well being produced by gas-lift equipment that operated on a time cycle and injected gas intermittently. The flow rate varied from zero to 2,415,000 cu ft per day. At approximately 7 a. m. the gas-lift valves stuck open and the differential pen arm moved off the chart. Approximately 15 min later the differential pen arm moved back onto the chart, and for approximately two hours gas was injected into this well at the rate of 2,100,00 cu ft per day. After this had continued for about two hours, the trouble was finally found and remedial measures taken, but it was not completely lined out again until approximately 12:45 in the afternoon.

The volume of gas from this particular lease averages, normally, approximately 250,000 cu ft per day, but on this particular day during the two hours that the gas-lift valves were stuck open a total of 175,000 cu ft of gas was pro-

duced into the plant gathering system.

By working closely with the producer, it has been possible to reduce the volume of gas lost due to gas-lift surges by changing the intermitters from 3 or 4 long injections to 20, or 30 short injections per day. In many cases the load was relieved on the gathering systems by alternating the injections of gas between two or more wells.

If a complete study of each well is not made when time cycle equipment is used, gas will be injected when it is not needed and thus create an unnecessary recycle of gas, which not only increases the load on the gas gathering system, compressor station, and plant, but is an added expense for the producer in compression costs in most cases.

Other types of gas-lift equipment work on the principle of pressure differential, injecting gas only when there is liquid in the well bore to be lifted. When metering on this or other types of gas-lift equipment, it is very difficult to integrate a 24-hr chart, but it would be a simple matter on a 1-hr chart. When two such charts were run on an integrator the 1-hr chart showed 24½ per cent less gas than was calculated for the 1-hr period on the 24-hr chart. Although volume involved during the 1-hr period is very small, the percentage variation in measurement is greater than one would like to see.

With close cooperation between the plant and field personnel and daily checking of gas volumes it is possible to locate and shut in wells having defective gas-lift valves until remedial work can be done.

A plant supplying gas for gas-lift purposes should keep the pressure on the gas supply system constant. If the gas pressure is allowed to drop below that required for lifting a well, it will cause a loss in production; and, if a well is off production for too long a period, it may be necessary to supply gas at a considerably higher pressure in order to kick it off again.

It is found that by explaining the problems in handling gas-lift gas to the producer, thus gaining his confidence and cooperation, some of the problems are eliminated.

Meter runs should be sized with the thought in mind of metering the extremely high surges of gas flow. Where a 2-in. or 3-in. meter run would probably measure all the gas, if it entered the oil and gas separator at a steady rate of flow, it might be necessary to use a 4-in. or even a 6-in. meter run with surge flow such as from gas-lift operations.

Another means used in sizing meter runs in order to have excess capacity is to size them for flange connections and have them fabricated with both flange and pipe taps. This has saved an expense for changing meter runs in several cases.

A few 50-in. meters have been used in gathering systems where gas-lift gas is encountered, but for readings at low rates as well as high rates of flow better overall results have been obtained by using at least a 100-in. meter. If a meter run is too small, a 200 or 400-in. meter might be the solution.

An integrating flow meter has been installed for measuring gas-lift gas and is still under test. This method should eliminate some of the human element error in trying to interpret the graphic record on the gas chart.

Some tests have also been performed to investigate the merit of using a displacement type liquid meter in place of an orifice meter for measuring gas-lift gas. Upon testing a liquid meter in series with a 100-in. orifice meter, the liquid meter registered 25 per cent less gas. Proper gearing or a correction factor should remedy this difference. The initial cost as well as maintenance cost of such an installation might prohibit its use. The possibilities of this method merit further investigation.

Low Pressure Gas Gathering

The design and operation of low pressure gas gathering systems presents problems in sizing, metering, location of drips, protection from corrosion, protection from freezing, the obtaining and maintaining rights-of-way, et cetera. The layout of the system will depend to a large extent upon the type and location of separator installations made by the producer. The installation of one central separator battery for an entire field has definite advantages from the economic standpoint of the gas purchaser. Two plants are operated that were first built with all the lease separators for each field installed within the plant fence. Under this type of operation, it was necessary for the flow lines to be any-

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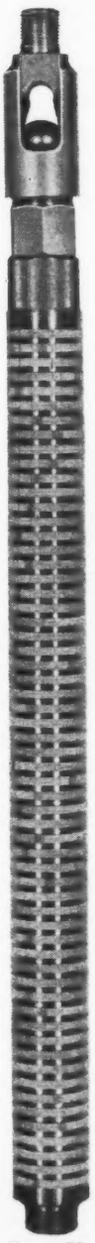

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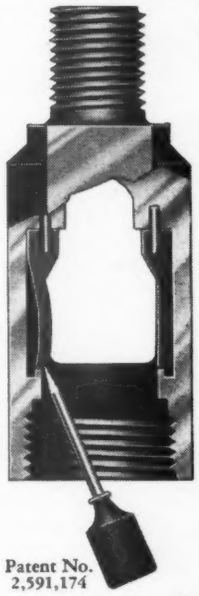

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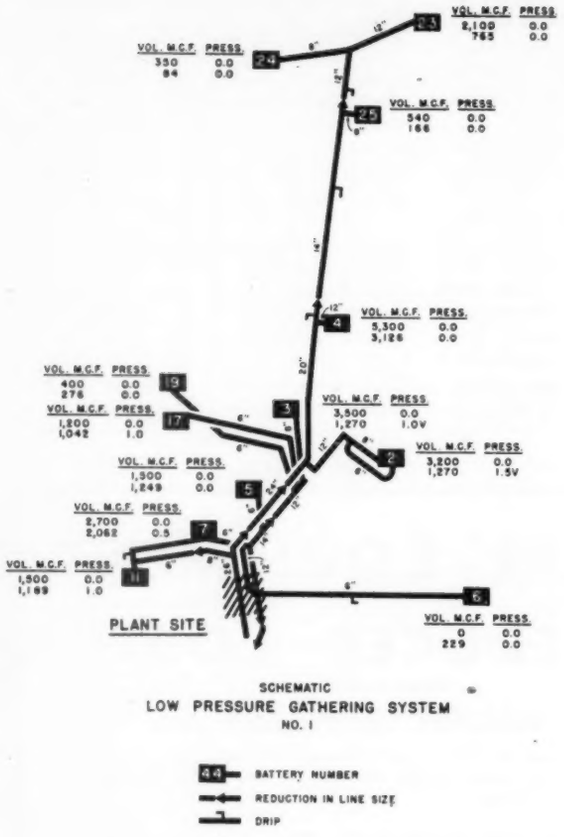

FIG. 4.

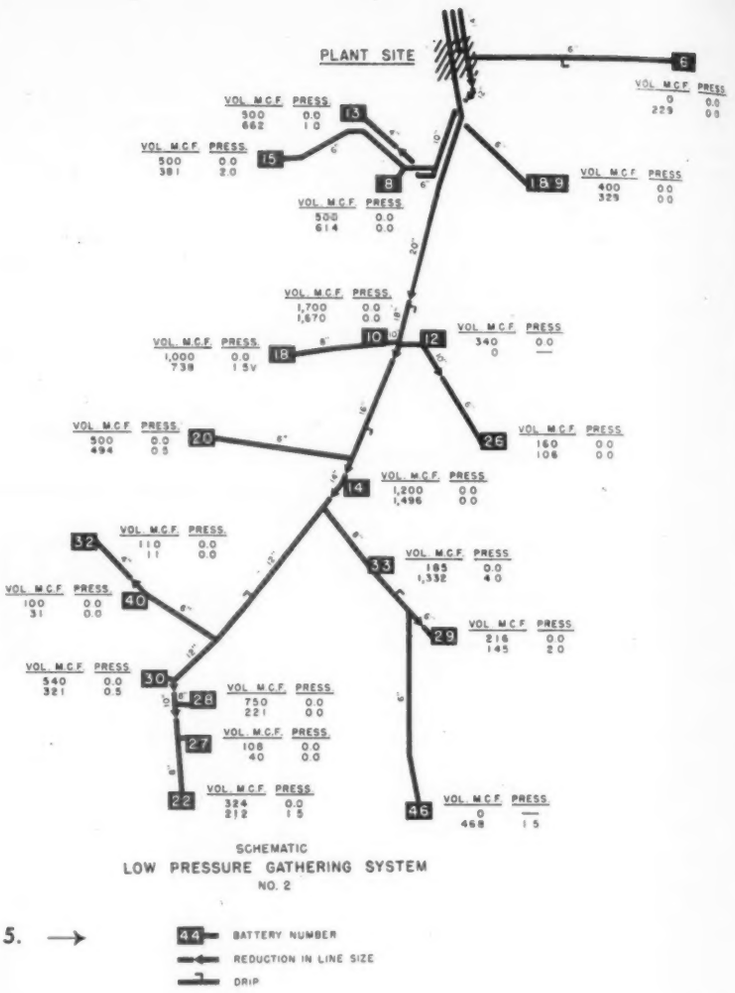

FIG. 5. →

where from a few hundred feet to over three miles in length. The operations at the start were very satisfactory, and it was possible to supervise operations closely and maintain equipment due to the compactness of this type unit. Very little difficulty, such as freezing of meters, controls, et cetera, was experienced, as an adequate supply of steam was available for heating regulators and other equipment during cold weather.

After a few years, at one of these plants, the pressures of the various wells declined to a point where they would not flow into the central separator battery. After a thorough study of the problems involved, such as the handling of large volumes of salt water, and the need of keeping the wellhead pressure as low as possible, it was decide to move all low pressure well separators from the plant to the wells. A low pressure gas gathering system was installed with adequate capacity to handle both the gas produced by low pressure flowing wells, and the gas used for lifting wells that became too weak to produce under their own pressure. Seven tank batteries were installed in the field with the idea of keeping the oil flow lines as short as possible.

At the other plant, because of the shortness of the flow lines, it was decided to leave the central separator battery within the plant fence. This battery was converted to a group of low pressure and a group of high pressure separators. To take care of the increasing volume of salt water and to treat the oil adequately a battery of heater treaters was installed adjacent to the separator battery. Facilities were also provided to boost the low pressure gas to absorber pressure for processing.

The producers usually install a central separator to serve a group of wells, but at times a separator is installed at each well. The type of installation to be made depends upon the characteristics of the field and the economics. From the standpoint of the gas gatherer, it is more economical to connect one central separator for a group of wells than to connect individual well separators for the same total volume of gas.

The sizing of a gathering system, especially the main lines, is sometimes difficult because the field development program is usually incomplete when the plant and gathering system are planned. A certain amount of future development can be anticipated and provided for in sizing the lines; however, it is not economically feasible to provide line capacity for some of the more optimistic expectations.

In sizing a gas gathering system, it is important to have the pipelines large enough to handle the available gas volume without causing undue pressure increases at the ends of the gathering system. From past experience it is known that sizing the gathering system for the expected average daily volume is not adequate. Some allowance in capacity must be made for peak gas loads. In the past the main lines have been sized for 15 to 33 1/3 per cent more gas than the expected average daily volume and this has been satisfactory in the majority of the cases.

Next is discussed a gas gathering system after its third revision. In making the third revision, the combined efforts of the producer, petroleum engineers, and plant personnel were employed. This system was to handle a daily average volume of 20,000,000 cu ft. The main trunk lines were designed for approximately 33 1/3 per cent more gas than the expected average daily volume. Each lateral was designed to handle the estimated maximum volume for each battery connected to it.

Fig. 4 shows the north end of this gathering system. The first row of figures at each battery shows the designed volume and the pressure one expected to carry at the separator. The next row of figures shows the actual volume and pressure at the separator for one day, January 13, of this year. The main lines from the north were designed to carry a total of 18,790,000 cu ft of gas per day to plant, but on January 13 they were only required to handle 12,499,000 cu ft.

Fig 5 shows the south end of the same gathering system. The main trunk lines on the south end of this system were designed to handle 7,986,000 cu ft of gas

per day to the plant, and on January 13th of this year they handled 9,271,000 cu ft. This is approximately 16 per cent more gas than designed capacity, but even with this overload, pressures on the separators are still within reason in nearly every case.

One of the reasons for the unbalanced load condition is the fact that deeper production has been found in the south end of the field since this system was installed. In order to keep the gas production within the capacity limits of the gasoline plant and compressor station, it has been necessary to shut in several high gas-oil ratio wells in various parts of the field. At the present time a study is being made of the entire area in order to determine what should be done to handle all the gas that should be produced.

Cooperation

A large step towards solving the sizing problem has been found in closer cooperation between the plant personnel, producer, and the Engineering Department. The present method for sizing a gathering system calls for a thorough gas survey by the gas tester and plant personnel. This information is correlated with data from the petroleum engineering and reservoir engineering sections. From these data all the factors are correlated, the oil and gas reserves, and potentials are worked out and a forecast made as to the expected gas production for a period of years. From this type of study a gas gathering system can be sized that will come nearer meeting the requirements.

In order to keep a plant at constant load, and at the same time to keep from flaring any gas, it is sometimes necessary to ask the producer to flow all wells as near as possible at their calendar day allowable. It should be remembered that it is not always easy for the producer to do so because some wells must be produced at higher rates in order to keep them flowing efficiently.

Above or Below Ground System

Whether to bury the gas gathering system or to install an above-ground system is a problem that has to be faced at the time each project is installed. Some advantages of buried lines are, generally less freezing, less stress on the lateral connections, less slack is required, improved above-ground appearances, and, in many instances, better relations with the land owners. Some of the disadvantages are, external corrosion, hard to find leaks, more expensive to repair and replace, deeper valve boxes and drip connections, and, generally, more expensive to install.

When underground gathering systems are installed, corrosion possibilities should be thoroughly investigated. To provide maximum protection for a long period of time, the best recommended installation is to coat, and wrap, and install cathodic protection.

It is pointed out that when the gas gathering lines are to be buried, climatic conditions must be considered in deciding the depth to bury them; for example in one operational area the pipelines must be buried with a minimum cover of four feet, otherwise it is better to leave them on top of the ground.

The company has several gas gathering systems that are installed above the ground. Some of these systems have given very little trouble and others have given considerable trouble. The company's experience on the installation of above ground gathering systems indicates that the lines should be installed on an even grade. It may even be necessary to install A-frames in some of the low places so that the above ground lines may drain to a few well placed drips. Ninety-five per cent of the freezing troubles have been encountered on the poorly graded lines.

Considerable trouble has been experienced with leaks where wrinkled bends were used on thin-walled pipe. Line breaks have occurred where light weight lateral lines have been saddled into thin wall trunk lines. One suggestion that has been made to help eliminate this trouble, is to install a short piece of standard weight pipe where lateral line connections are to be made.

Whether an above ground or a buried gas gathering system is installed, it is highly recommended that drips be installed to protect the system adequately from condensation and separator carryover. It is also recommended, that the drips be made from heavy pipe rather

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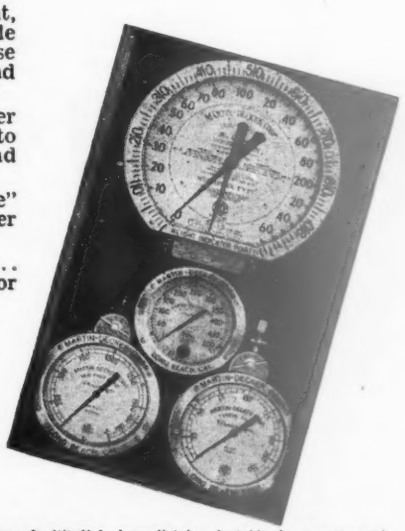

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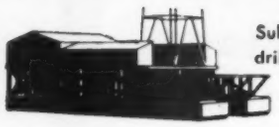

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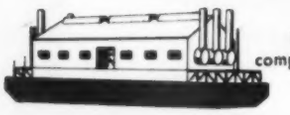

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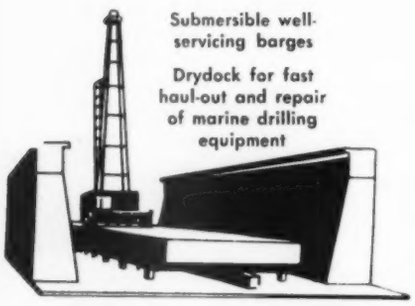

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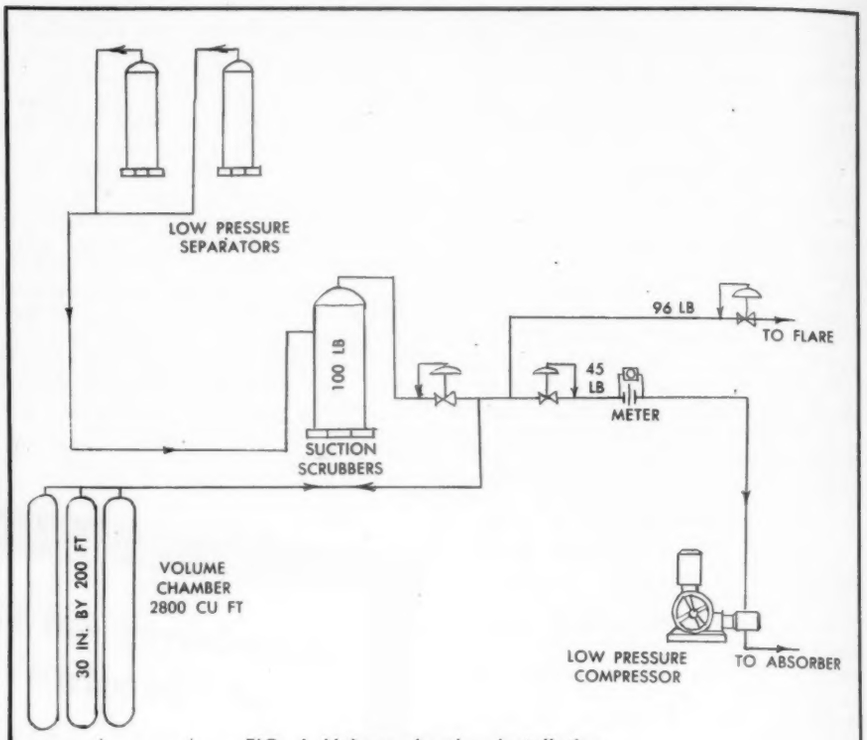

FIG. 6. Volume chamber installation.

than thin wall pipe to allow for corrosion.

The lack of properly placed block valves in gathering systems has caused considerable operational difficulties during line breaks. Valves are expensive and careful study should precede their installation. Unless the gas to be flared during a repair job is a very small quantity, the minimum installation should include a valve on each lateral at the main trunk line. In a great many cases, it may be economical to install a valve on the main line just upstream from the laterals.

One recent problem was the flaring of 2 to 2,500,000 feet of low pressure gas daily because of insufficient compressor capacity, and the erratic flow of low pressure wells. The greatest part of the erratic flow is due to gas-lift operations. In this particular case, the separators are very close to the plant and the low pressure gas gathering system has very little surge capacity. Gas charts from the flare meter in this particular case were as follows. One chart was the regular 24-hr, and other a gas flow chart which made one complete revolution in one hour. A differential reading of 60 in. on the chart is equal to a rate of flow of 8,393,000 cu ft per day. Careful study of the flare charts, over a period of time, indicated that when the gas heads reached the plant the excess gas would flare for approximately six minutes. They also indicated that additional compressors alone would not necessarily prevent flaring unless compressor capacity was installed for the very peak conditions. On the 1-hr chart, a circle was made on the 6-in. differential line, which indicated a flow of 2,655,000 cu ft of gas per day. If compressors were put in to handle this volume they would be underloaded as much of the time as they were overloaded. Fig. 6 shows the proposed solution to this problem. It was decided to install a portable compressor with a capacity of approximately 3,000,000 ft of gas per day and to install a volume chamber between the pressure control regulator to the compressors. The pressure on the volume chamber will vary between 45 lb and 100 lb. Calculations indicate that this volume chamber will allow, practically, the elimination of the gas flare.

Communications

There are other problems such as safety, and the obtaining and maintaining of rights-of-way that should be considered in producing and gathering low pressure gas. Last, it is necessary to emphasize the necessity of solving one of the most difficult, and yet the most important problem of all—that of communications. Production personnel and plant personnel should be acquainted with one another's operating problems, and should recognize the fact that these problems can be solved or minimized to the advantage of both. No phase of operation is quite so important as a good communication system. By making good use of the communication system, better cooperation between producer and plant personnel is made possible and will solve a great many of the problems in producing and in gathering low pressure gas.

Acknowledgment

The author wishes to acknowledge the various members of the Continental Oil Company for their assistance in the preparation of this paper. * * *

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1. **EXTRA LARGE GRIPPING SURFACE** in the now famous Du-all Slips. These Slips reduce possibility of fish distortion—even under heavy, repeated jarring!
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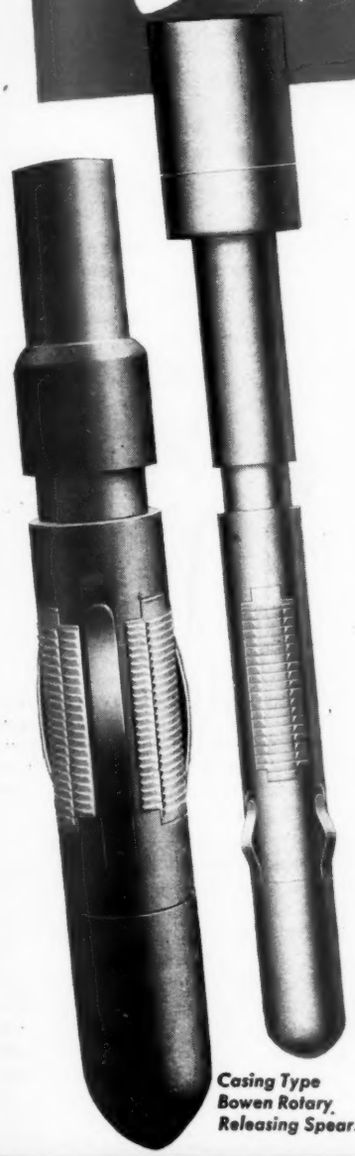
3. **INSTANT RELEASE AT FRACTIONAL TURN** permits raising or lowering the fishing string to best engagement position—and re-engagement of Spear to fish again requires only a fractional turn!
4. **FREE ROTATION RIGHT OR LEFT** of the fishing string is possible by integral keys on the Spear body which stop the slips in a set or released position, whichever is desired at any given time.
5. **CIRCULATION IS MAINTAINED** by simple installation of a Bowen Pack-Off Attachment on the lower portion of the Bowen Rotary Releasing Spear—after fish is securely engaged, full circulation can be maintained through the fish.
6. **PRE-ENGAGEMENT FISH CONDITIONING** to assure positive internal engagement is easily accomplished by attachment of a Bowen Mill Type Nut—right rotation both mills the fish and drills out sand or corrosion.
7. **POSITIVE CONTACT IN LARGE HOLE OPERATIONS** is assured by the design of Skirts and Guides available for all Bowen Rotary Releasing Spears—good insurance for proper alignment and easy entrance.



Casing Type Bowen Rotary Releasing Spear.

Tubing and Drill Pipe Type Bowen Rotary Releasing Spear.

There is a Bowen Rotary Releasing Spear designed specifically for *your* fish when it is to be engaged internally. Available from Bowen stores in your territory—sold outright for export only.

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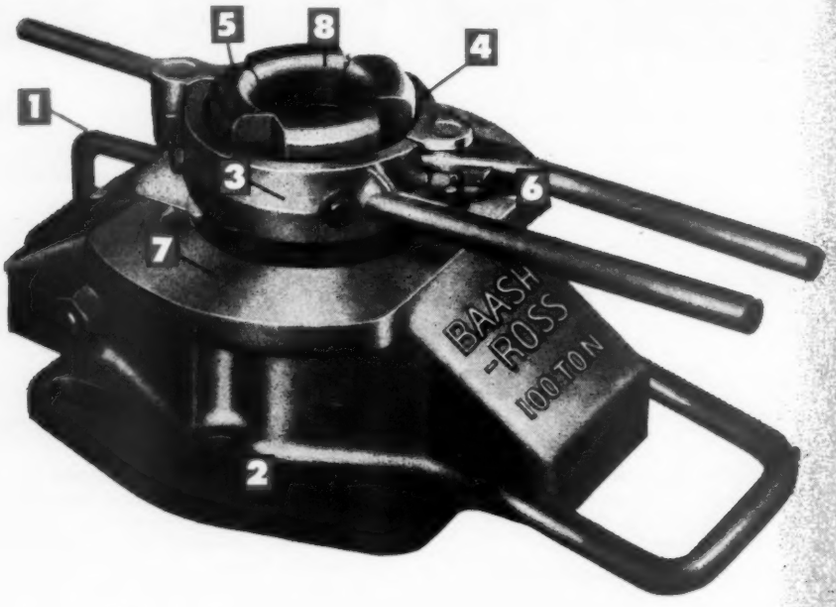
Want faster, safer, simpler tubing jobs?

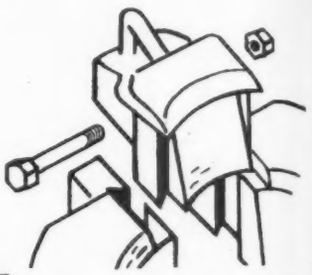
Compare these advantages of the

Baash-Ross

OPEN END TUBING SPIDER



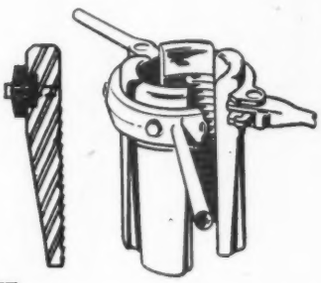
Here's a Tubing Spider really *engineered* for modern tubing operations. It is unusually simple to set up and its other unique operating features assure faster trips, smoother crew efficiency, greater safety. Check over these advantages . . .



1 DOVETAILED END GATE speeds setting up for tubing jobs. Simply lift the gate out, slide the Spider into position and drop the gate back in place. The dovetailed joint between gate and body prevents spreading under the heaviest loads. Also, a bolt is provided for locking gate and body together.

2 SLOTTED OPENINGS in the bottom flange simplify bolting the spider to tubing head flange or any other supporting surface for safe, rigid operation.

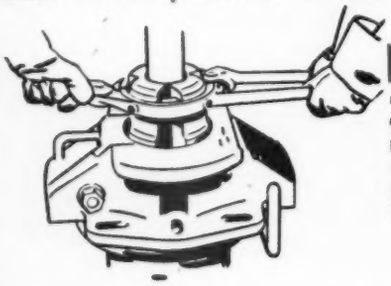
3 THE FOUR SLIP SEGMENTS are unitized together on a hinged tong that maintains exact alignment at all times. They grip together, release together—assuring a uniform tubing grip.



4 THE SLIPS ARE GROOVED to dovetail with the tong—they are not merely bolted to it. Thus, all slip alignment loads are transmitted directly to the tong itself. No shearing stresses of any kind are placed on bolts or other retaining parts!

5 THE SLIPS ARE LONG—10" overall with a full 9" gripping surface. Even the longest and heaviest tubing strings are handled easily without damaging the pipe.

6 TO LOCK THE SLIPS around the tubing, simply close the handles. To release, merely spread the handles . . . no extra operations are necessary. The lock holds firmly under all loads and will not open accidentally.



8 FOR ADDED SAFETY note how the slip segments extend above the handles to provide ample clearance and protect the crew's hands against injury from the elevators.

7 A WIDE FLAT PLATFORM is provided on top of the Spider body for supporting the Slip Assembly when out of the bowl. There's even a ridge around the outer rim to keep the Slips from sliding off!

These and still other features add up to faster trips, safer operations, greater protection to pipe and higher all-around operating efficiency on all types of tubing jobs . . . at all depths!

The Baash-Ross Open End Tubing Spider is available in two sizes—one for handling tubing 3" in diameter and smaller, and the other for 4" tubing and smaller. See your nearest Baash-Ross representative for complete details—or write direct!

Sold through leading supply stores

See our Exhibit at the Tulsa Oil Show!

Baash-Ross

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Airborne electro-magnetometer in operation. Helicopter flies at an elevation of between 50 and 75 ft at speeds of less than 40 miles per hour. It can survey and render an analysis on 800 to 1000 sq miles a month.

Electro-Magnetometer for Exploration

Finding petroleum is difficult and methods are sought continuously that will assist in determining the possible areas of accumulation

WILLIAM RINTOUL

AFTER an intensive three-year research and development program an airborne electro-magnetometer* especially designed for use on a helicopter was recently put into commercial operation.

This new instrument tackles the job of finding out what the earth looks like below its surface by measuring the magnetic field — a measurement which then may be translated mathematically into a contour map.

Needless to say, ever since the first geologists discovered that one was more apt to find oil by drilling into an anticline instead of a syncline, oil men have been interested in anything that might help them to detect the earth's hidden "hills and valleys."

Component parts of the airborne electro-magnetometer are the recorder, computing device, and magnetic detector. Installation on the helicopter† requires less than half an hour. The recorder is mounted directly in the cockpit in front of the magnetometer operator. The computing device is mounted between the operator and the pilot in the helicopter. The magnetic detector, commonly known as the "bird," is attached rigidly to the longerons forward of the tail rotor and is connected to the computor by means of cables. Weight of the electro-magnetometer is only 207 lb.

Measurement of the magnetic field is recorded on a strip chart with pen and ink. Use of a standard strip of paper 10 in. wide for a strip chart affords an opportunity for critical measurement of variation of the earth's magnetic field in gamma units. For example, the total magnetic field in California is 50,000 gammas. The electro-magnetometer can record a high degree of detail as it will measure 1/50,000 part.

After the record is made, it is possible to draw maps and contours of the granitic basement. The contours will suggest any earth movement subsequent to oil occurrence and indicated anticlines and/or synclines enable the geologists to determine inferentially the location of possible oil-bearing strata.

The instrument is intended for use as a reconnaissance device that can narrow the search by showing those areas of greatest interest and also those areas where oil obviously could not occur. After the areas of greatest interest are singled out, it is advisable to employ seismic exploration for pin-pointing the actual drilling site.

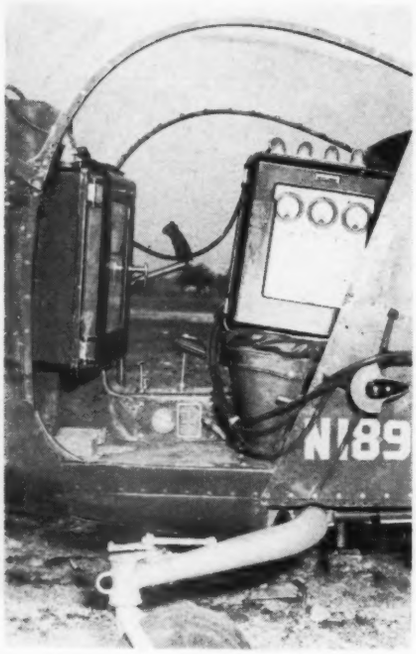
Ability has been demonstrated in actual use to survey, compute results and render a complete analysis on the magnetic properties of 800 to 1000 sq miles per month. This coverage of large areas in a minimum of time is expected to justify the consideration of large and hitherto unexplored regions.

Design of the electro-magnetometer was such as to exploit to the fullest the ability of the helicopter to maintain a constant low-level altitude and slow airspeed over most types of terrain. Obtaining detailed records is permitted by the helicopter's ability to fly safely at an altitude of 50 ft and slowly, never more than 40 miles an hour.

Ability of a helicopter to land on almost any terrain, or with floats when used over water, makes it ideal for the type of reconnaissance work planned

*Kern Copters, Inc., of Bakersfield and Gamma Surveys, Inc., Los Angeles, California.
†Bell 47-D.

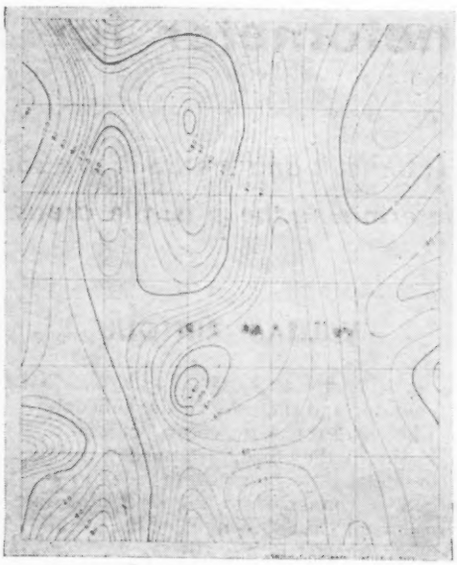
EXCLUSIVE



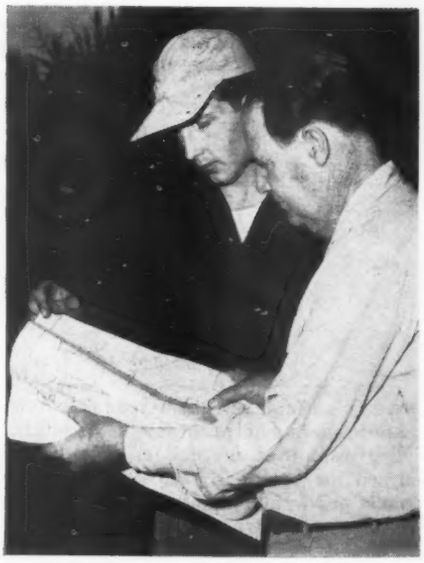
Ready for operation, the recorder is installed in front of the magnetometer operator while the computor rests between the operator and the helicopter pilot.

Mounting the "bird," the magnetic detector which transmits its information to the computor, which in turn is connected to the recorder.

Strip chart with variations recorded by airborne electro-magnetometer.



Contour map based on aerial survey by electro-magnetometer.



Studying the lay of the land before taking off on a survey assignment are (left to right) Bob Didier and Jimmie Arnold of Gamma Surveys, Inc.

for the electro-magnetometer work. It can reach far away and inaccessible places, which are for the most part the frontiers of the oil exploration business.

Extensive tests were made in California's Mojave Desert, an almost deserted region. It was an ideal region in which to determine magnetic susceptibilities and their effects on the records, for within the space of a few miles it was possible to find pre-Cambrian, Pliocene, Miocene, and more recent formations exposed.

As development progressed, the instrument was tried out in proved oil fields in Kern County, California, and in Texas, where results could be compared with results already obtained by seismographic surveys.

One of the first jobs for the airborne electro-magnetometer was for Tex-Harvey Oil Company of Midland, Texas. It involved surveying about 100 square miles of land near Brenham, Texas, and it took less than two weeks to complete the job and deliver the contour maps to the company. A two-man team, helicopter pilot and magnetometer operator, flew over grid lines a mile apart and later more closely, where the records showed faults. As a result of these surveys the discovery well of the Harvey-Wilcox field was substantially credited to the airborne electro-magnetometer. As a matter of interest the well was a 9424-ft wildcat and was completed flowing oil at a potential of 650 bbl a day.

Although the airborne electro-magnetometer was developed primarily for use in finding oil, it may also be used for mineral prospecting and particularly for the location of iron-bearing formations and other minerals of high magnetic susceptibility. * * *

TEXAS

• Processing of gas at the Three Bar Gas Injection and gasoline plant was begun recently, it was announced by John R. Evans, division manager of Stanolind Oil and Gas Company's North Texas-New Mexico division. The plant is part of a project designed to increase the ultimate recovery of oil from the Three Bar field.

In 1951, three of the four producing companies in the field — Stanolind, Champlin Refining Company and Superior Oil Company—entered into a unitization agreement; and the fourth operator in the field, Humble Oil and Refining Company, joined with the other three in a cooperative gas injection program. Gas from both the unit and the Humble area, which is in the northern portion of the field, is being processed in the plant. Stanolind is operator of both the plant —owned jointly by the four companies —and the Three Bar Unit.

Gas compression operations were started last November at the new plant, located in the Three Bar field approximately 17 miles southwest of Andrews, Texas. Using three 1320-hp gas-engine driven compressors, the plant can presently handle up to 11,000,000 cu ft of gas per day. Installation of two additional 1320-hp compressors will be completed this April to increase the compression capacity to 18,500,000 cu ft per day.

Total producing area includes some 5,000 acres, with 56 producing wells and 3 injection wells. Casinghead gas from the producing wells reaches the plant at a pressure of 3 psig and is compressed to the absorber operating pressure of 700 psig. Residue gas is compressed to 2700 psig for injection into the producing formation. Expected daily recovery at the 11,000,000 cu ft per day capacity will be approximately 15,000 gal of 12-lb gasoline, 20,000 gal of butane, and 23,000 gal of propane.

Process heating in the plant is done by direct gas-fired heaters and by circulating hot oil. Stripping steam used in distillation is obtained from a steam generator utilizing hot oil as a heat source. One small oil field type boiler is used to provide steam for tracing and miscellaneous heating jobs in cold weather. Power is supplied by three 400-kw gas-engine driven generators. Two 50,000 bbl underground salt cavaties, to be completed within the next few months, will be used to store butane and propane recovered in the plant.

The company has about 40 employees at the plant. Plant superintendent is G. A. Ayling, W. A. Bice is plant clerk, and G. H. Sanders, plant engineer. C. B. Pierce is Stanolind's field project engineer in charge of construction. The prime contractor for the plant design and construction is the Hudson Engineering Corporation of Houston.

• F. E. Hatfield, Gulf Oil Corporation, is in charge of general arrangements for the American Petroleum Institute Division of Production Southwestern District meeting which will be held at Fort Worth, Texas, March 4-6. Predicted attendance is 1000 or more executive and technical oil men from Texas, New Mexico, Louisiana and Arkansas.

• Scurry Area Canyon Reef Operators Committee put into effect the special order of the Railroad Commission of Texas approving the unitization agreement for 47,000 oil producing acres in the Kelly-Snyder and Diamond "M" canyon lime fields of Scurry County.

An estimated 720,000,000 bbl of additional oil may be obtained by the secondary recovery operations for oil and gas, which the operators will put into effect under the Commission's unanimous order authorizing the program through a coordinated gas and water injection pressure regulation program.

Owners of about 96 per cent of the working interest and owners of about 85 per cent of the royalty interest within the outer limits for the Unit area already have signed the unitization agreements. R. F. Bryant, Jr., Magnolia Petroleum Company, Dallas, chairman of the SACROC Land Committee, declared his committee expects additional signatures.

Under terms of the unitization agreements, working interests and royalty owners may voluntarily join the new SACROC unit within six months of the starting date of the unit operations. Application to enter the unit after that date will be on a negotiated basis with SACROC. The present basis of participation is set by formula using a well factor of 25 per cent and a gross acre feet factor of 75 per cent.

ISRAEL

• In a letter dated November 7, 1952, the Iraq Petroleum Company confirmed to the Government of Israel that no rights were claimed by it under the various oil prospecting licenses which the Company had been granted in 1939 by the British Mandatory Government of Palestine:

"We are pleased to confirm our agreement that no rights are claimed and no obligations on the part of the Company exist under oil prospecting licenses number one to eleven granted on twenty-fourth of February, 1939, and fourteen to thirty-one granted on July 21, 1939 (published in supplement number two to the Palestine Gazette number 873 of March 23, 1939, and number 912 of August 24, 1939 respectively) which shall be deemed to have been surrendered by us."

WILLISTON BASIN

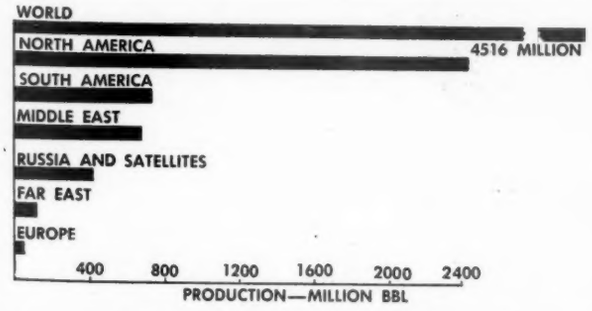
• The speaker for Williston's second annual Oil Celebration Day has been selected. He is Dr. Robert E. Wilson, chairman of the board of Standard Oil Company of Indiana.

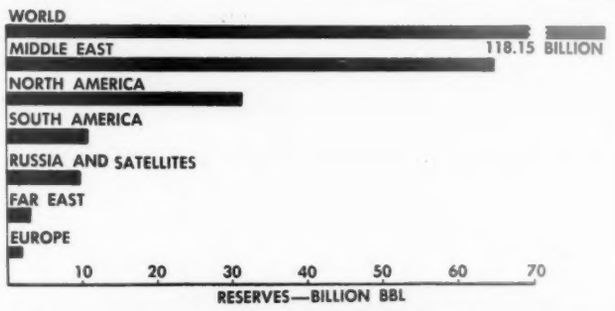
Under the sponsorship of the Williston Junior Chamber of Commerce, the oil discovery celebration will be held April 18, according to Holger Smitt, chairman in charge of arrangements.

The annual celebration marks the anniversary of the discovery of one of the nation's largest new oil fields on April 4, 1951. Since the initial discovery, more than 100 producing wells in four major fields have been brought in.

The annual event features a public barbeque at which, last year, more than 7000 persons were served. In addition, visitors and townspeople are entertained with a mile-long parade of progress, carnival, banquets, contests, and other scheduled programs.

An attempt is made each year to select a speaker whose company has provided the largest contribution to North Dakota's snow-balling petroleum industry. Last year, Albert Jacobson, president of the Amerada Petroleum Corporation of Tulsa, Oklahoma, was the principal speaker. Amerada attended the birth of oil development with the bringing in of the now-famous Clarence Iverson well near Tioga and Williston.





International Operations. In 1952 total oil reserves of the world was increased by 15 per cent when compared with 1951 figures. Increase was approximately 15,000,000,000 bbl. World's annual oil production for 1952 was 248,607,000 bbl more than in 1951, an increase of 5.8 per cent. Daily average production throughout the world is presently 12,339,000 bbl. Of this, the United States produces 50 per cent, Middle East 16.9 per cent, Venezuela 14.5 per cent, and Russia and sattelites, 9 per cent. Bulk of present world production is concentrated in Western Hemisphere.

XUM

TOOL PUSHER
"We wouldn't think of running a string of drill pipe without using NO-GALL on the tool joints."

DRILLER
"In all my experience with drill collar compounds, I've found STEEL-AID does the best job of thread protection."

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DRILLING SUPERINTENDENT
"We've standardized on WECO Compounds. Their No-Gall and Steel-Aid can be depended on for uniform high quality and proper thread protection for tool joints and drill collars."

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NO-GALL TOOL JOINT COMPOUND

NO-GALL, with more than 50% PURE METALLIC ZINC, dispersed in a neutral oil with tacky additive, protects tool joints and prolongs their life. NO-GALL will not harden . . . requires no thinner . . . is unaffected by hot or cold weather.

STEEL-AID THREAD COMPOUND

STEEL-AID, containing 67% PURE METALLIC LEAD, is made specifically for drill collars, bit joints, Christmas Tree assemblies and other high pressure assemblies. It is non-hardening . . . requires no thinner.

HI-SPEED SEAL THREAD COMPOUND

HI-SPEED SEAL assures leak-proof connections on casing, tubing, steam lines, oil and gas lines and other threaded connections. HI-SPEED SEAL is non-hardening . . . requires no thinner . . . seals with less torque.

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News

U.S.A.

• F. W. Brigance, president American Association of Oilwell Drilling Contractors, states that:

The Rotary Drilling Committee recently met in Dallas to formulate a work program for the year. It was agreed that AAODC should carry the ball in development of the daily drilling report as the API recently started work on such a project. Agreement already had been reached on the type papers to be presented at the thirteenth annual meeting at Denver. A special topical study on "Tool Joints and Methods of Preventing Wear" will be developed, and there is every reason to believe that this project will be a very important one. The committee also has begun development of a tool pushers' manual. This will be a long-range project and will include information on practical and technical aspects of the pushers' duties. It is expected that a great deal of progress will be shown on this study.

KANSAS

• Warren-Bradshaw Exploration Company of Tulsa, Oklahoma, has announced opening of a Wichita, Kansas district office. E. H. Wood, Jr., will head the Kansas office from which all activities of the company in Kansas and the Julesburg Basin will be handled. Wood was formerly associated with the Vickers Petroleum Company as chief scout.

WASHINGTON

• Walter S. Hallanan, chairman of the National Petroleum Council has announced the appointment of a committee to study and report on the petroleum capacity of the United States as of January 1, 1953. Such a study was requested by Hallanan, who stated that the most recent of these reports on "Petroleum Productive Capacity" dated January 29, 1952 has been found valuable and of great assistance to the Federal Government and particularly to the Petroleum Administration for Defense. He added it is now desirable to have up-to-date figures on present productive capacity of crude oil and of natural gas liquids.

It is headed by L. F. McCollum, president of the Continental Oil Company.

Others appointed to the committee are: Hines H. Baker, president, Humble Oil and Refining; Max W. Ball, Washington, D. C.; H. S. M. Burns, president, Shell Oil; J. P. Coleman, president, National Stripper Well Association; Howard A. Cowden, president, Consumers Cooperative Association; E. DeGolyer, Degolyer and MacNaughton; J. C. Donnell, II, president, Ohio Oil; Paul Endacott, president, Phillips; R. G. Follis, chairman of the board, Standard California; Robert L. Foree, Texas Independent Producers and Royalty Owners Association; B. I. Graves, vice president, Tide Water; Jake L. Hamon; B. A. Hardey; John Harper, president, Harper Oil.

D. A. Hulcy, president, Lone Star Gas; A. Jacobsen, president, Amerada Petroleum; B. Brewster Jennings, president, Socony-Vacuum; John M. Lovejoy, president, Seaboard Oil; Charlton H. Lyons, president, Independent Petroleum Association of America; A. C. Mattei, president, Honolulu Oil; N. C. McGowen, president, United Gas Corporation.

E. E. Pyles, vice president, Monterey Oil; Ralph O. Rhoades, Gulf Oil; R. S. Shannon, director, Pioneer Oil; P. C. Spencer, president, Sinclair Oil; Stewart M. Vockel, president, Waverly Oil Works; W. K. Warren, chairman of the board, Warren Petroleum; L. S. Wescoat, president, Pure Oil, and Robert E. Wilson, chairman of the board, Standard Oil (Indiana).

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You get the COMPLETE down-hole story in just ONE RUN with Western's new GAMMATRON* (simultaneous radioactivity well-logging). Perfectly correlated GAMMA RAY and NEUTRON CURVE calibrations are obtained immediately this modern way. You get an accurate picture of the formations penetrated by your drill stem, and — you get it in HALF the time! Think what this means in rig-time and logging costs saved!

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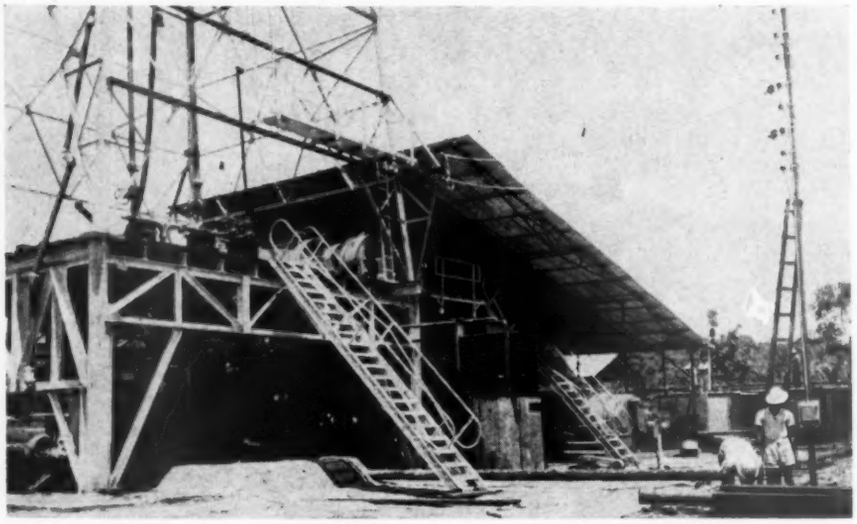
What's Doing in Drilling



General view from the rotary drive side of the Ideal Type 130 Rig operated by Apex (Trinidad) Oilfields, Ltd., for deep drilling near San Fernando, Trinidad.

TRINIDAD, B.W.I.

• A large number of large American made diesel-powered rigs are now engaged in deep exploratory drilling. Trinidad Leaseholds, Ltd., and Trinidad Petroleum Development Company are both operating with this type equipment. Apex (Trinidad) Oilfields, Ltd., is using a heavy rig with a drilling range of 10,000 to 16,000 ft, and the bulk of this equipment was shipped from The National Supply company plant in Torrance, California, on March 6, 1952. Well was spudded-in on July 23, 1952.

OKLAHOMA

• Shell Oil Company had another good well completion in its Elk City field recently. The Rumberger No. 4 was drilled to a depth of 10,053 ft and the pay was perforated between 9724 to 9860 ft. Initial flowing production was 497 bbl per day of 61.6 gravity oil on a 22/64-in. choke. Gas oil ratio was 6714:1. Shell's Kelly "C" No. 4 plugged back to 10,131 ft came in at 512 bbl oil per day on a 22/64-in. choke. This new completion was perforated from 9762-9841 ft. Gas oil ratio was 7431:1 and the gravity 61.4.

• Wilcox Oil Company had a successful completion after a Sandfrac treatment on the Sac-Fox No. 31 well in Lincoln County. Initial flowing production was 400 bbl oil per day on ¼-in. choke. The productive pay is the Prue sand topped at 3065 ft. Total depth of well is 3156 ft.

• Tide Water Associated Oil Company has a dual zone oil well completion in the Sholem Alechem field in Carter County. The pay sands are the Humphreys and Goodwin. Total depth is 7466 ft and 5½-in. casing is set at 7417 ft. The Goodwin was tested through perforations at 7358-70 ft and flowed at the rate of 450 bbl per day on a 3-hour test. An excessive gas-oil ratio necessitated the perforations at 7224-56 to be squeezed off. Perforations at 6157-59 ft had some 18 bbl oil per hour. The Humphreys was perforated at 6094 to 6120 ft, and at 6134-57 ft with an initial flow of 28 bbl oil per hour.

VENEZUELA

• Development drilling operations on a modest scale were continued by Venezuelan Atlantic Refining Company during 1952 on wholly-owned and joint-interest concessions in the Saban and Ruiz areas of the State of Guarico (Eastern Venezuela). During the 12-month period ended November 30, 1952, a total of 21 net development wells was drilled in these areas, of which 16 wells were producers. Gross production, as of November 30, 1952, from wholly-owned and joint-interest concessions, was approximately 18,000 bbl per day. Net production was about 10,000 bbl per day.

A limited exploratory program was conducted in Eastern Venezuela.

NEW MEXICO

• A northwest extension to the West Lovington Abo pool of Lea County, New Mexico, was indicated in a drillstem test at Cities Service Oil Company's State AE No. 2. The well flowed 34 bbl of oil in two hours in a test of the Abo limestone between 8279 and 8349 ft. In the 321-minute test, gas to surface in nine minutes, and oil in 186 minutes. The well is centered in SE NW SW, Sec. 36-16s-36e.

MONTANA

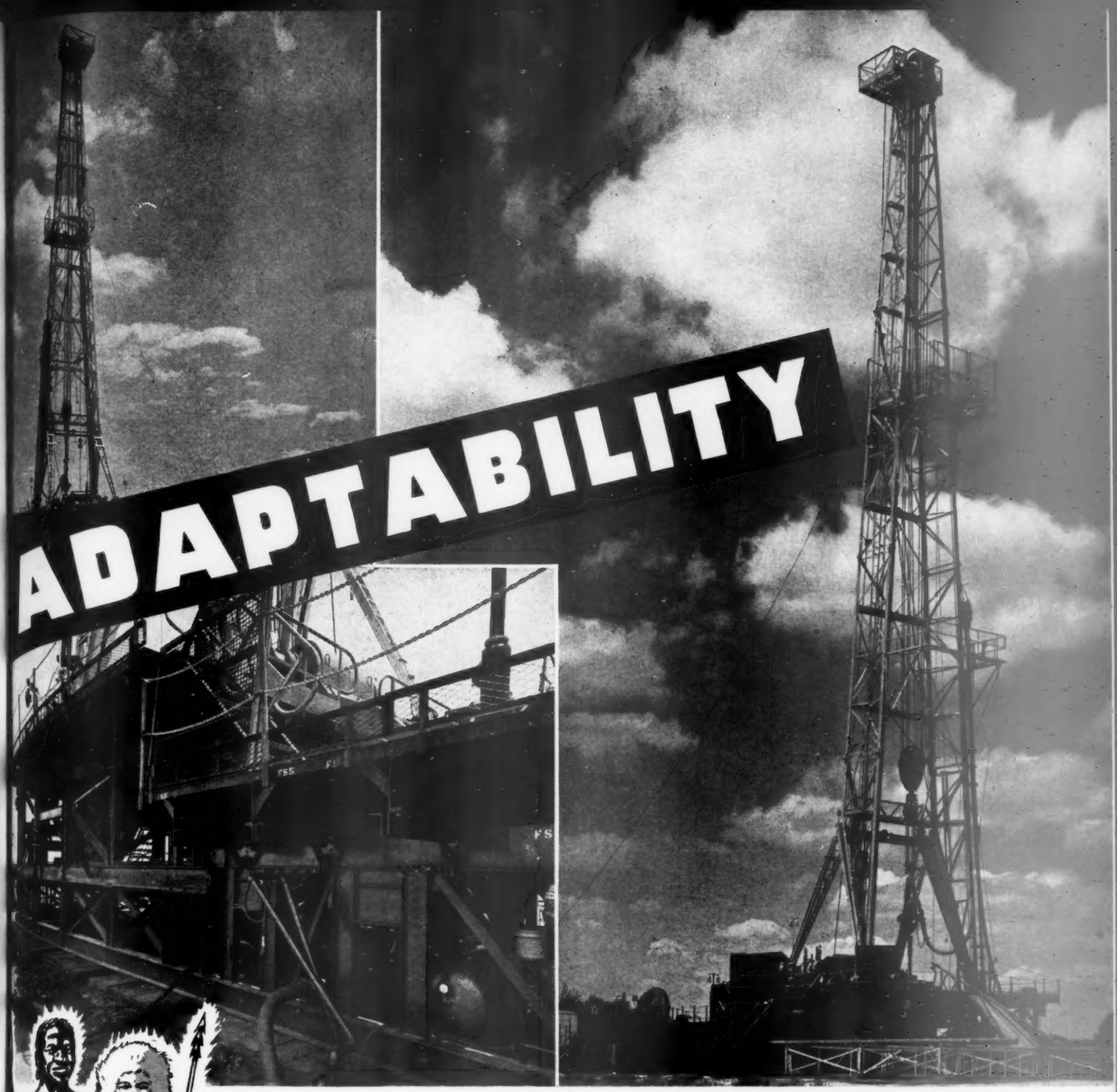
• The Texas Company has earmarks of a good well in Rosebud County near Sumatra. It is the company's No. 1 Amon, which recovered 1850 ft of oil and 150 ft of oil-cut drilling mud on a drillstem test from 4770 to 4784 ft and has set pipe for tubing. Total depth is 4850. It is a north offset for the No. 1 Grebe, discovery well for the pool.

MISSISSIPPI

• Barnett Serio, Gulmon and Johns have completed an oil well, No. 2 Ligon-Mazique, in the Sibley field in Adams County. A section of the Wilcox series, Robinson sand, was perforated from 6430-33 ft with an initial production of 275 bbl per day on the pump, the gravity was 40.

• A difficult completion was accomplished by Humble Oil and Refining Company on its T. P. Wilson well in the Gillsburg field in Amite County. The step-out has 37 bbl per day pumping oil production with a gas-oil ratio of 306 and gravity of 37.1. Perforations were in the Tuscaloosa sand at 11,730-38 ft. The hole was drilled to 11,925 ft and 7-in. casing was set at 11,882 ft. The original perforations were at 11,736-43 ft and the well flowed at the rate of 240 bbl per day during a 7 hour test on a ¼-in. choke. B. S. & W was 40 per cent. By the end of the test the salt water content was 85 per cent and in consequence this zone was squeezed off.

In Salem oil field near Salem, Illinois, a ¾ yd Lorain backhoe, model TL25K, is shown at work on a 14-in. line for the Texas Co. water-flood. At this point, the Lorain owned by the L. R. Young Construction Company of Olney, Illinois, is digging a bell hole measuring 8 ft wide at the top, 6 ft at the bottom and 6 to 8 ft in depth.



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Drilling

TEXAS

• Honolulu Oil Corporation has extended the southwest portion of the Weddell Spraberry field in Sterling County. Testing the interval 5077-5102 ft, gas surfaced in 5 min and oil in 57 min. Production was 16 bbl per hour for 4 hours, flowing. Top of the Spraberry is 5054 ft and casing is to be run with an open hole completion.

• Tennessee Production Company has stepped-out successfully a half mile to the northwest in the new East Huffsmith field, Montgomery County, near Houston. From a drillstem test 2900 ft of oil was recovered from the interval 5834-5837 ft. Casing is being set for completion. Company leases cover 4000 acres in the area.

• Successful completion of a second discovery well in the Mungerville sector of Texas' Midland Basin oil region by Ponder Oils Incorporated, wholly-owned 7-month-old United States subsidiary of Canadian independent oil company, Ponder Oils Ltd., Calgary, was announced by Paul Moseson, Ponder president.

LOUISIANA

Barnett Serio, an independent operator and drilling contractor of Natchez, Mississippi, recently completed Savage No. 1 in Wildsville field in Concordia Parish. The well extends the field by one mile to the northwest. The initial flowing production was 187 bbl oil per day on an 1/8-in. choke. Complete well data have not been released to date. The top of the pay is reported to be at 5095 ft and the oil column is 14 ft. As two dry holes were previously drilled between the field proper and the present location it may be that a new reservoir has been found.

• Union Sulphur and Oil Corporation has made an important gas-distillate discovery in the parish of Jefferson Davis, South Louisiana. The sand was topped at 12,360 ft and flowed at the rate of 2,500,000 cu ft of gas per day on a small choke. The condensate production is 40 bbl of 40.42 gravity per million cu ft. The productive gas zone is believed to be 160 ft thick. Some 155 ft of additional pay has been reported higher up the hole.

COLOMBIA

• International Petroleum, Ltd., Standard Oil Company (New Jersey) affiliate, has completed a third Totumal well in Columbia. It was completed after reacidization of a cretaceous lime and shale section. The well flowed at the rate of about 400 bbl of 26 gravity oil per day through 3/8-in. choke on potential test. The company completed its No. 2 Totumal in 1952 for a potential of about 75 bbl daily and plans to acidize the formation.

WASHINGTON, D. C.

• New estimates are being prepared on the number of oil and gas wells the domestic petroleum industry will drill in 1953, '54, and '55, the Petroleum Administration for Defense has announced. Figures will be used to estimate requirements for oil country tubular goods to be used in well drilling, PAD announced, adding that these requirements will be compared with estimated production by steel mills of casing, tubing, and drill pipe that will be needed by the oil industry.

Consultants are: Richard Gonzalez, Humble; Minor Jameson, Independent Petroleum Association of America; Paul R. Schultz, Jr., Stanolind Oil, and Henry McAuliffe of Socony Vacuum.

CANADA

Britco Oils Limited reports that the first well on a quarter-section in the Namao oil field, puchased by a group of five independent Canadian oil companies for cash bonus of $55,100, has been spudded-in and is now drilling below 500 ft. The well, Antone-Trans Era-Britco et al Namao No. 1, was staked a quarter-mile south of a lower cretaceous well owned by Blue Crown Petroleums and Associates, and contract was awarded to Marta Drilling Company.

• Namao, approximately eight miles north of Edmonton, was the scene of an Imperial Oil success last November. The new venture is drilling for the Lower Cretaceous horizon, at depth of approximately 3700 ft. Britco's other holdings include a 30,000-acre Crown Reservation in southwest Manitoba, an interest in the producing Mic Mac No. 3 oil well at Leduc, and three producing natural gas wells in southwest Ontario.

Deepest well drilled to date in Alabama is Humble Oil and Refining Company's No. 2 Emma Williams, drilled to 15,729 ft. The well was dry at that depth, so was plugged and completed in the Lower Tuscaloosa Sand, between 5408 and 5418 ft. It is in the South Carlton field in Washington County.

ALABAMA

Stanolind has completed its newest producer in the Pollard pool of Escambia County. It is the company's No. 2 Gray Unit, which flowed 82 bbl of 27 gravity oil through 1/4-in. choke. Gas-oil ratio of 4-1 was noted. Flow is from Massive formation.

• Gulf Refining Company has completed the No. 4 T. R. Miller in the Pollard field, Escambia County. The well is flowing at 106 bbl oil per day and the gravity is 27.6. The Massive sand was perforated at 6002-06 ft. The hole was sidetracked at 5423 ft and was finally bottomed at 6021 ft. This is the eighth twin-well completion in the field.

• Humble Oil and Refining Company has completed its No. 7 Crosby in the Pollard field. The well was brought in on the pump at the rate of 76 bbl per day, gravity 26.2. The Massive sand was perforated at 5992-96 ft and total depth was 5998 ft.

CALIFORNIA

• Discovery of a new producing zone in the Chowchilla (California) gas field was announced by Tide Water Associated Oil Company following completion of its well Redman-Stone No. 1-7 flowing at an estimated rate of 5,000,000 cu ft daily. The well, drilled to a total depth of 2776 ft, is situated on a block of 8626 acres held jointly by Tide Water and Chowchilla Gas Company.

• Tide Water Associated Oil Company, Western Division, has announced the successful completion of its V. L. & W. Well No. 75, Ventura Avenue field, flowing at the rate of 447 bbl net oil, gravity 34.1, from a depth of 11,525 ft.

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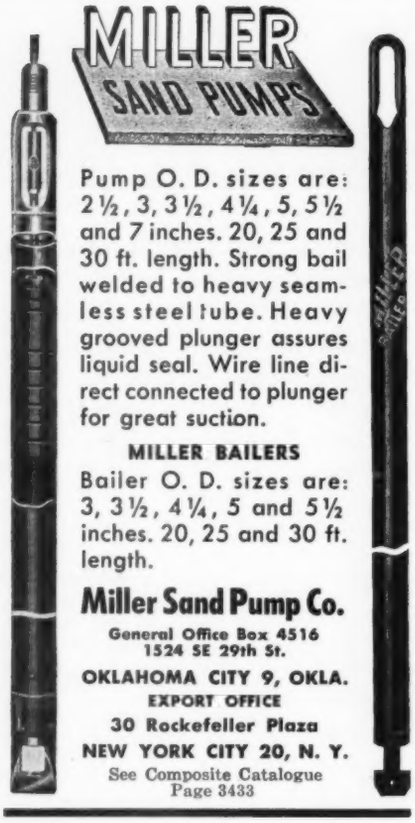

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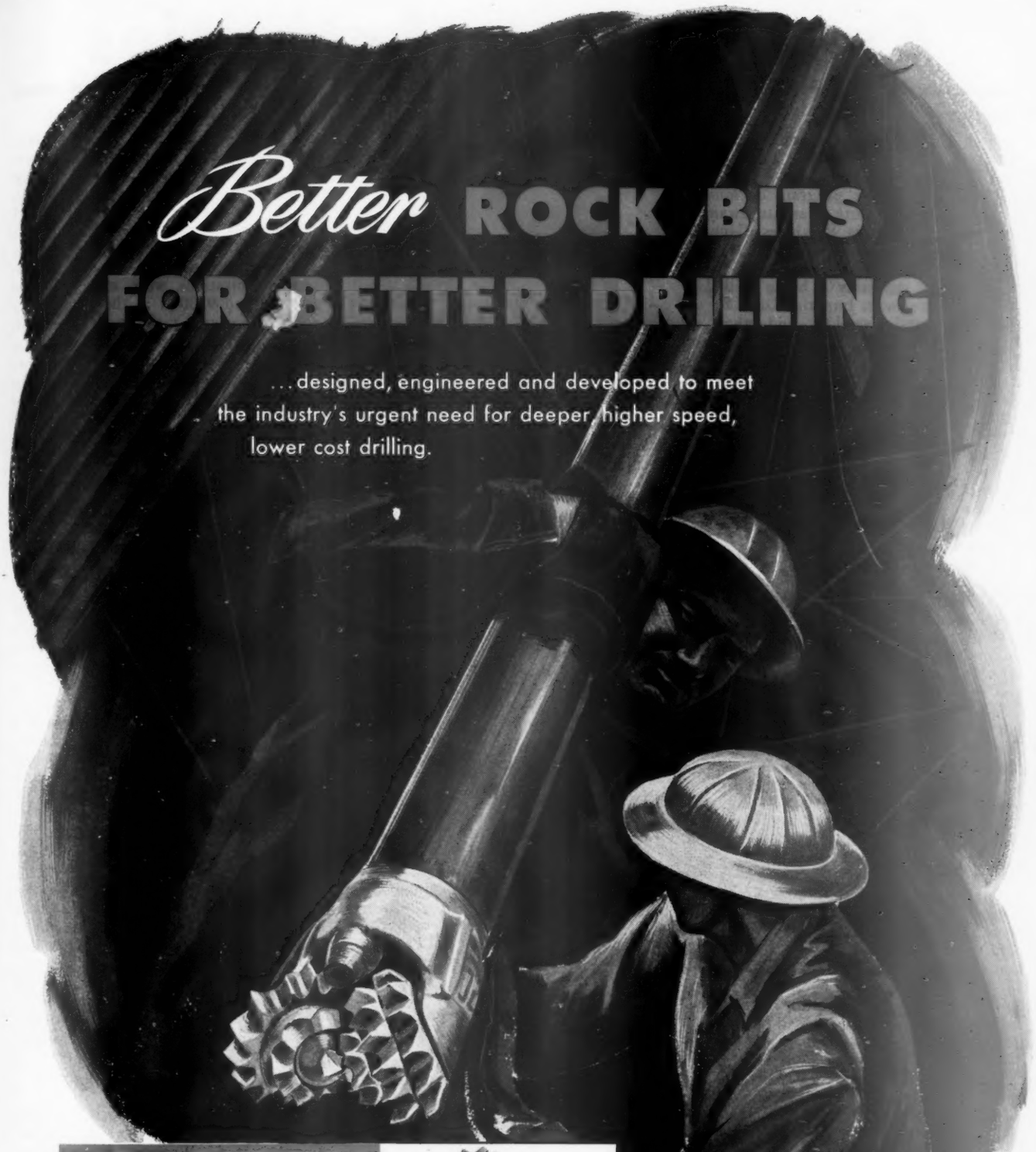
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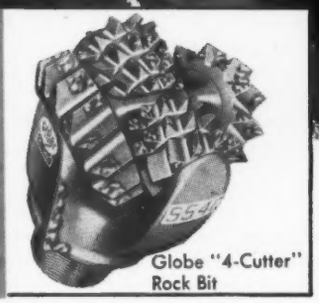
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To obtain more information on products advertised see page E-43

Exploration Activities

CANADA

• Preliminary field organization of Canadian Bishop Oil, Ltd., has been completed and the company is prepared to launch an active program of land acquisition in Alberta, Saskatchewan, and British Columbia Provinces. Canadian Bishop already has a lease interest in 18,000 acres in Saskatchewan, on which a well currently is being drilled in partnership with Imperial Oil, Ltd., Calvan Oil and Gas, Ltd., and others. In British Columbia the company has an interest in four British Crown exploration permits totaling 80,000 acres.

Canadian Bishop's four wholly-owned wells in the Redwater field of Alberta Province are continuing to produce at the full allowable combined rate of 244 bbl per day. The company also holds a number of leases totaling 2540 acres, Cessford area of Alberta.

• Tide Water Associated Oil Company has announced discovery of a new oil field that appears to be of major importance in Eastern Saskatchewan, Dominion of Canada. The new discovery, near the town of Forget, tested porous lime in the interval 3852 to 3895 ft, and on a short drill stem test flowed clean 29.5 gravity oil at the rate of 3600 bbl per day.

Tide Water Associated Oil Company has heretofore announced the completion of two other discovery wells in Saskatchewan, involving two separate areas, one at Wapella, 40 miles north of the new discovery at Forget, and the other at Eastend, 325 miles to the west of the Forget well.

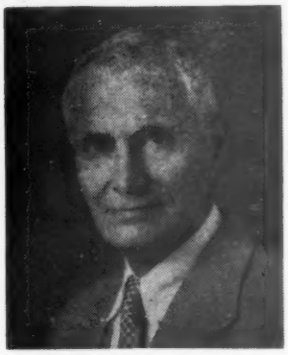
NEBRASKA

• Sunray Oil Corporation's first oil production in the state of Nebraska has been brought in at the company's Sunray Nelson-Rasmussen No. 1, Kimball County, producing on pump at the rate of 74 bbl per day. The well is in the Southwest Potter field of the Denver-Julesburg Basin, and was completed in the Gurley or "D" sand at 5540-46 ft, having also encountered saturation in the "J" sand. Location has been staked for a second well 1320 ft east of the new completion.

LOUISIANA

• With the completion of a wildcat well, State Terrebonne Bay No. 49, in Caillou Island field, Terrebonne Parish, Louisiana, The Texas Company announces the discovery of a new productive horizon and extension of the producing area on the west flank of the field.

The wildcat, owned jointly with Louisiana Land and Exploration Company, flowed at the rate of 149 bbl of distillate per day through a one-sixth inch choke, and had a gas-oil ratio of 12,098:1. Tubing pressure was 3950, and gravity 47.4. Perforations were made between 11,505 and 11,515 ft in the new pay horizon, which will be named the "Terrebonne Bay No. 49 sand."



Frederic Henry Lahee

Frederic Henry Lahee, Sun Oil Company, Dallas, Texas, has been named recipient of the Sidney Powers Memorial Award of the American Association of Petroleum Geologists' Award will be given at the association's annual meeting in Houston, Texas, March 24.

Award is given for outstanding achievements in and continuing contributions to the field of petroleum geology as an educator, author, skilled administrator and executive, and as a pioneer in the gathering and use of hydrocarbon reserve and exploration data.

This award is named in honor of the late Sidney Powers, 14th president of AAPG. Only 6 other geologists have received the gold medal, the first being Wallace E. Pratt in 1945. Dr. Lahee, a graduate of Harvard University, joined Sun in 1918.

Dr. Donald Frederick Towse, associate professor of Geology, University of North Dakota, will receive the President's Award at the AAPG meet. Award is given annually to author under 35 whose article in Association bulletin is judged as contributing most to petroleum geology. His article was "Frontier Formation, Southwest Powder River Basin, Wyoming."

FLORIDA

• Sinclair Oil and Gas Company has begun drilling on Key Largo, Florida, of its first wildcat well in that state, it was announced recently. The well is located in Monroe County, about 40 miles south of Miami.

Known as the No. 1 H. R. Williams, the test well is located on a block of 171,500 acres, part of which is on Key Largo, part in the shallow sounds and bays toward the mainland, and part on the ocean side of the key. Sinclair obtained a one-half interest in the block late in 1952 from the Commonwealth Oil Company, one of the considerations being the drilling of this wildcat well to a depth of 10,500 ft. Exploration work for the well was all done by Commonwealth, which has considerable lease holdings in the state of Florida. Sinclair has no oil production in the state, but has oil and gas leases that total opproximately 300,000 acres in other parts of the state of Florida.

TEXAS

• The Texas Company has announced the discovery of a new oil field three miles west of Big Lake in Reagan County, West Texas, with the completion of a wildcat well, State of Texas A C Well No. 1, which flowed at a daily rate of 288 bbl of 51.70 deg gravity oil through an 18/64-in. choke on the latest test. Perforations were made between 9410 ft and 9500 ft in the Ellenberger lime. The gas-oil ratio was 2340 to one.

• Sinclair Oil and Gas Company has completed a new producer in Schleicher County, for a daily flowing potential of 342 bbl of 40.5 gravity oil plus 40 bbl of acid water. Total depth of well is 8045 ft, and gas-oil ratio, 1285-1.

• Cities Service has a large gas discovery in Pecos County, at its No. 1 Payton. The well was gaged at the rate of 272,000,000 cu ft of gas daily. The well blew out, but was later brought under control. This is West Texas' largest gas well, and one of the largest in the state.

• Cities Service and Continental Oil companies have a Devonian show at their University AR No. 1 Ellenburger test in Upton County, Texas. On a two-hour drillstem test from 10,016 to 10,040 ft, operators reported gas to the surface in seven minutes, with flow estimated at a daily rate of 842,000 cu ft. Approximately 180 ft of light-green distillate and 30 ft of gas-cut mud were recovered. Operators are drilling ahead to the Ellenberger, expected at approximately 12,000 ft.

• Lone Star Gas Company and Lone Star Producing Company are operating from their new West Texas exploration and gas supply district headquarters in Midland, according to announcement by E. A. Brown of Dallas, exploration and gas supply division manager and vice president of the producing company. All activities around oil and gas developments in West Texas and New Mexico will be handled out of the Midland office.

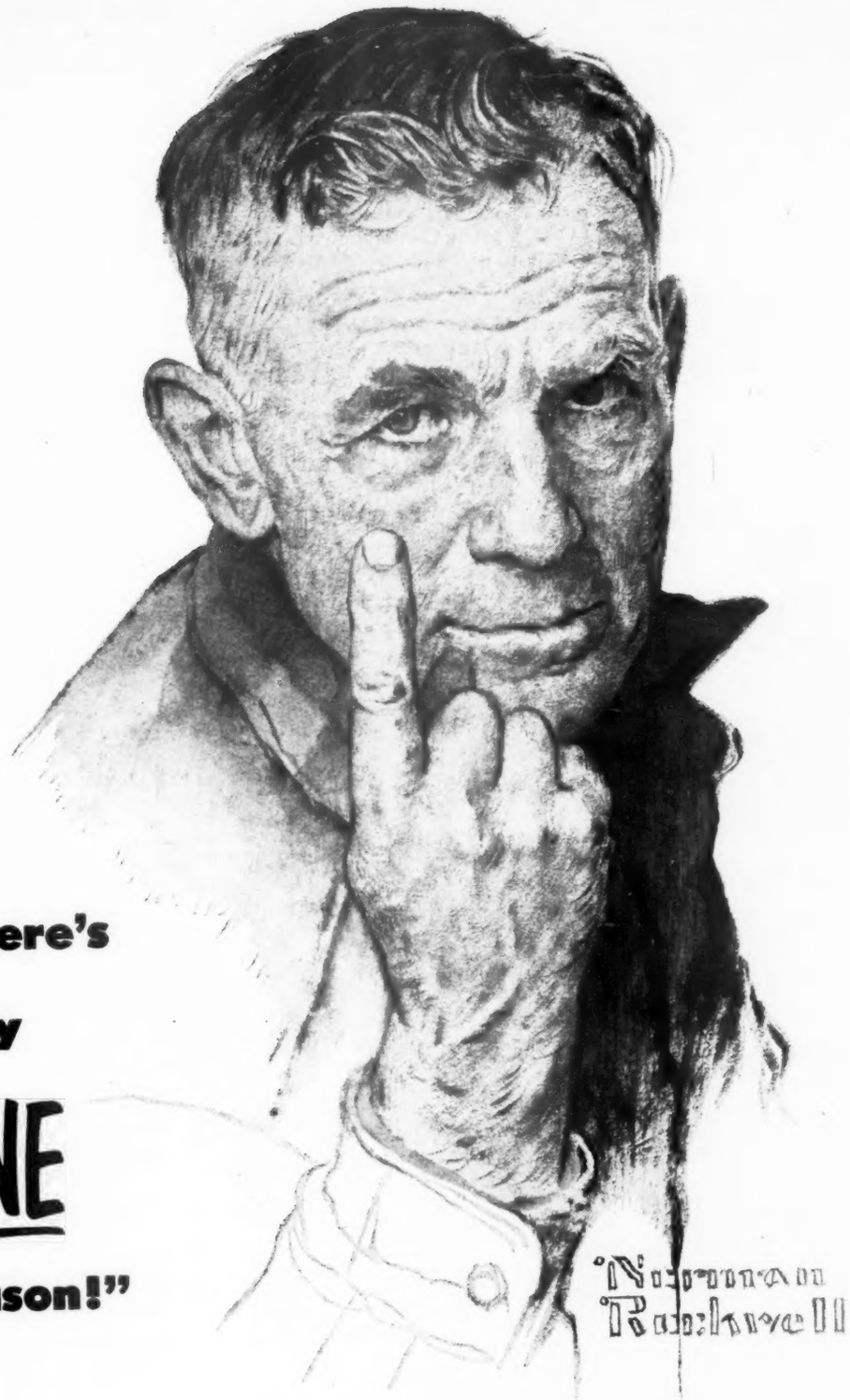
KANSAS

• A rank wildcat has been brought in as a successful pool opener in Sheridan County. It is Westpan Hydrocarbon Company's No. 1 Wessell, which swabbed 120 bbl of 38-gravity oil in 24 hours.

• Midstates Oil Corporation has reported a multiple-zone oil well in Rooks County. The company's Roll Williams "A" No. 1 well pumped oil at the rate of 576 bbl daily from the Arbuckle lime at a depth of 3739 ft.

COLORADO

• Sherrod and Apperson, Inc., may have a new gas field in Weld County, at their No. 1 County. On drillstem test of the "J" sand, the well flowed an estimated 5,000,000 ft of wet gas a day. Total depth is 6455 ft, and location is about 2 miles northeast of Chapelton.



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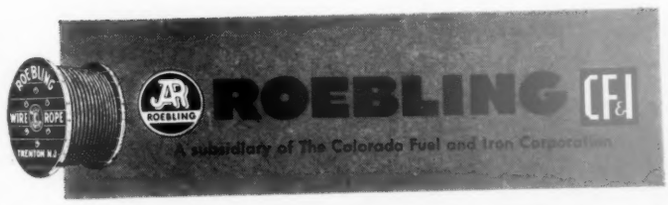

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Exploration

NEW YORK

• Drilling and Exploration Company president, Clarence A. Wiggins has announced the merger of Petroleum Exploration Company and Twin Oil Corporation, two affiliated companies. Consolidated company will be known as Twin Oil Corporation.

MICHIGAN

• Panhandle Eastern Pipe Line Company is testing the Niagran formation in St. Clair County. The hole was drilled to 2374 ft, and after finding some production in the Basal Salina from 2276 to 2348 ft it was deepened to 2374 ft. Showing some gas, zone was acidized with 6000 gal. It then flowed and gaged 7,011,000 ft the first 24 hours.

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WILLISTON BASIN

• Cities Service Oil Company has staked location for a Devonian test on its 9600-acre Kempf Ranch block in Yellowstone County, Montana. The test is Buyse No. 1. It will be drilled to the Devonian, expected at approximately 8000 ft. Tests on the Frontier, Dakota, and Tensleep sandstones and the Madison limestone will be made.

• C. H. Murphy Corporation has a good show of oil in the Heath sandstone from a well in the eastern Montana portion of the Williston Basin. The well recovered 390 ft of clean black, 36.9 gravity oil, in a drillstem test from 4891-4901 ft. If the well proves productive, it will open a new producing horizon for the Williston Basin.

• LeRoy H. Hines, vice president—oil development, Northern Pacific Railway Company, announced that Northern Pacific had concluded two leases with Stanolind Oil and Gas Company on Northern Pacific lands in McCone County, Montana, in the Williston Basin. Amerada Petroleum Corporation will hold an undivided one-half interest in the two leases.

The first area (Southwest Weldon area) involves aproximately 8860 acres of Northern Pacific lands, and the lease requires the drilling of a well on Northern Pacific lands within 90 days from the date of the lease to a maximum depth of 11,500 ft.

The second area (Lindsey area) involves approximately 7150 acres of Northern Pacific lands, and the lease requires the drilling of a well on adjacent lands, leased by Stanolind from the State of Montana, within 90 days from the date of the Northern Pacific lease, to a maximum depth of 11,500 ft.

Both leases provide for payment of 30 per cent royalty to Northern Pacific and are on substantially the Northern Pacific lease form.

NEW MEXICO

• Albuquerque Associated Oil Company has reported a new natural gas well in Sandoval County, New Mexico. The well No. 1 Torreon-X promises to produce 500,000 to 1,000,000 cu ft of gas a day on the basis of a drillstem test. The well is 25 miles from the nearest production, in the old Hospah field.

• Texas Pacific Coal and Oil Company has a new wildcat in Lea County, which may prove to be a discovery well for the Pennsylvanian formation. It is the No. 1 Lane-Mills, which on a drillstem test, recovered 4480 ft of 42.4 gravity oil and 400 ft of oil and gas-cut mud.

OKLAHOMA

• The No. 1 Brown "A" in Pottawatomie County swabbed 500 bbl of oil in 22 hr from Trenton sand perforations 4266 to 4274 ft. The well is W. C. Jackson's well, which has a plugged back depth of 4349 ft. Casing is set at 4385 ft.

• Magnolia Petroleum Company has a Garvin County well, flowing at the rate of 566 bbl of oil in 24 hours. It is the No. 1 Duncan, which is through a ½-in. choke from Springer sand perforations between 9101 and 9062 ft.

SAUDI ARABIA

• Crude oil production in Saudi Arabia during January amounted to 24,208,230 bbl, or an average of 780,911 bbl per calendar day, it was announced by the Arabian American Oil Company. December production was 22,716,838 bbl, an average of 732,801 bbl per day.

NORTH DAKOTA

• A possible pool opener has been discovered at a wildcat well in McKenzie County, North Dakota, recovering oil. Well is the No. 1 George Wollan drilled by Amerada Petroleum with Pacific Western and Skelley Oil supporting the venture. It flowed 106 bbl of 43-gravity oil and 30 bbl of water in the first 24 hours from the limestone at 9066-9110 ft. The Wollan is 3 miles northwest of Amerada's No. 1 Balverson in the Keene area. Nearest producing well is Amerada's No. 1 North Dakota D in the Charlson area 6 miles from the Wollan.

• An area land and exploration office has been opened in Bismarck, North Dakota, by Deep Rock Oil Corporation, John L. Ferguson, vice president, has announced. Harry W. Hitt is area landman and John C. Meyer area geologist there. Deep Rock's area offices in Wichita Falls and San Antonio, Texas, are being extended, the executive said, with F. E. Melott being named head of Wichita Falls office and M. E. Forney as head of the San Antonio office. William Ford has been appointed economic assistant and R. B. Hurlbutt assistant to the manager of the geological department in Tulsa, Oklahoma.

MEXICO

• Gulf Sulphur Corporation has a large sulfur formation in the Isthmus of Tehuantepec in the state of Veracruz, Mexico. It has been drilled to 940 ft, and 130 ft of sulfur-bearing formation has been recovered. Drilling is proceeding.

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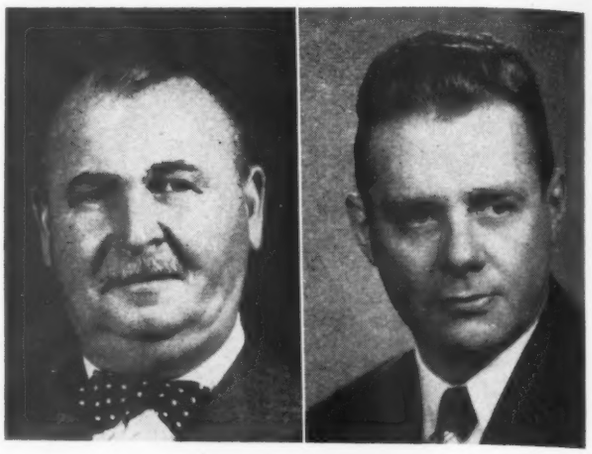
▸ **J. W. Pittman,** Shell Oil Company's New Orleans area production superintendent and former Lake Charles production division manager, has been named Shell's production manager for the southern states' area east of Texas, with headquarters in New Orleans, to succeed **E. N. Van Duzee,** recently assigned to New York.

Pittman, a native of Center, Texas, has been production superintendent for three years. He was Shell's Lake Charles division manager from 1946 to 1948, and assistant division manager there previously. He is a Texas A & M graduate.

▸ **Bill Iversen** has been named president of Kansas Geological Society for 1953. Other officers are: **George Link,** secretary-treasurer; **Brian Kirby,** vice president, and **Bob Walters,** board member.

▸ **H. Ben Cox** of Bartlesville has been appointed to the newly-created position of manager of exploration for the Southern division of Cities Service Oil Company, with headquarters in Houston, Texas. Cox, who has been connected with the company for nearly 30 years, has been superintendent of the land department with headquarters in Bartlesville, Oklahoma. He will be succeeded in that position by **J. W. McColl,** who has been assistant superintendent of the department.

Robert L. Jones is division geololgist for the Southern division; **Robert E. Hart** will be division land man and **W. T. Lee** is division geophysicist.



D. J. Griffin is new chief landman of the Ohio Oil Company's production department, and G. R. Schoonmaker, right, is new senior gelogist.

▸ **N. D. Smith, Jr.,** has been appointed director of the exploration and production research division of Shell Development Company. Dr. Smith's headquarters will be in Houston. A graduate of the University of Texas, Dr. Smith later received his MA and PhD in physics from Harvard University. He joined Shell in 1935 as a seismologist in Tulsa.

▸ **Ludlow Shonnard, Jr.,** was elected vice president of Southern Counties Gas Company at a meeting of the board of directors recently. He was previously manager of personnel and claims. As vice president in charge of personnel, he will continue to direct the personnel and claims departments. He will also assume full responsibility for industrial relations of the company's business.

▸ **D. J. Griffin** has been named chief landman of The Ohio Oil Company's production department. Griffin, who has been Ohio Oil's district manager at Calgary, Alberta, since 1949, will move to the general office at Findlay, Ohio.

G. R. Schoonmaker, senior geologist of the company's foreign division, has been appointed Calgary district manager succeeding Griffin.

Griffin joined Ohio Oil Company in 1922 as a warehouseman in the Casper, Wyoming, division. With the establishment of Ohio Oil's foreign division in 1949, he was appointed district manager at Calgary, Alberta.

A geology graduate of the University of Chicago in 1939, Schoonmaker worked for a year with the U. S. Army Engineers at Omaha, Nebraska. He was employed by Ohio Oil in 1940. He went to Canada in 1949, and two years later became senior geologist of the foreign division.

Dr. F. G. Baptista

Dr. Domingo Casanova

Jack Enen

▸ **J. L. Ford,** district superintendent in Tia Juana, Maracaibo Lake area, Creole Petroleum Corporation, was transferred to Maracaibo as acting division assistant manager. **L. A. Summers,** district superintendent in Jusepin, Eastern Venezuela, was made district superintendent in Maracaibo.

Federico Baptista, assistant district superintendent in La Salina, Maracaibo Lake area, was made district superintendent in Caripito, Eastern Venezuela. **Hugh Wynn** will replace Baptista in La Salina.

L. M. Eldridge was transferred from Quiriquire field, Eastern Venezuela, to Tia Juana, replacing Ford. **Domingo Casanova** was transferred from Pedernales field to Jusepin as acting district superintendent. Announcement was made by Dr. Siro Vazquez.

▸ **Jack Enen** has been appointed district superintendent of warehouses for Gulf Oil Corporation's Gulf Coast production district replacing **M. H. Gaffney** who recently retired. Enen was first employed by Gulf at Luling, Texas, in 1929. During World War II he served in Washington for one year as chief, production section, foreign materials branch, with the PAD. Prior to that time he had served with the Gulf Company at Harvey, Louisiana, and in Houston.

▸ **John Emery Adams,** senior geologist, Standard Oil Company of Texas, Midland, Texas, will become the 37th president of the American Association of Petroleum Geologists on March 26. Serving with Adams on the 1953-54 executive committee of the world's largest geological organization will be **Morgan J. Davis,** as past-president, and three other newly-elected officers of the Association: Vice president **Leslie M. Clark,** director and vice president, Pacific Petroleums Ltd., Calgary, Alberta, Canada; secretary-treasurer **Elliott H. Powers,** vice president, Southern Production Company, Inc., Fort Worth, Texas; and, as editor of the AAPG monthly Bulletin of Petroleum Geology, **Armand J. Eardley,** chairman, division of earth sciences, University of Utah.

Retiring members of the present AAPG executive committee are past-president **Frank A. Morgan,** vice president, Richfield Oil Corporation; vice president **John G. Bartram,** consulting geologist, Stanolind Oil and Gas; secretary-treasurer **John W. Clark,** chief geologist, Magnolia Petroleum, and **Kenneth K. Landes,** geology department, University of Michigan.

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Marsh S. Watson, Jr.

William J. Travers, Jr.

H. H. Arnold

▸ **Marsh S. Watson, Jr.,** has resigned as water flood engineer for Richardson and Bass in the West Texas division and joined the firm of Buckles and Hostetler, oil production consultants, Monahans, Texas. Watson is a petroleum engineering graduate of New Mexico School of Mines, and received a Masters degree in petroleum engineering from the University of Oklahoma. He has been active in the water flood projects in West Texas for the last three years.

▸ **William J. Travers, Jr.,** has been elected a vice president of Richfield Oil Corporation by the board of directors and has been appointed manager of the exploitation department, in charge of drilling and producing operations of the company. He succeeds the late **Richard D. Montgomery.**

Travers has served as assistant manager of the exploitation department since 1945. He joined Richfield in December, 1928, as a petroleum engineer. In 1937, he took charge of Wilmington development as division petroleum engineer and from 1939 to 1945 he was superintendent of the San Joaquin Valley division.

▸ **H. H. Arnold, Jr.,** will join California Texas Oil Company, Ltd., as a vice president in the company's producing division. Arnold attended Colgate University, as well as the School of Mines, University of Pittsburgh. He was graduated from the latter, after majoring in petroleum geology and engineering, in 1927. He joined The Texas Company in August, 1927, at Houston, Texas, and in the next 11 years did geological work principally in the Oklahoma division.

▸ **E. E. Marshall,** assistant district superintendent, Conroe district, Gulf Coast division, Humble Oil and Refining Company, was promoted to district superintendent, Livingston district, succeeding **Lee Ellzey,** retired. Marshall was succeeded at Conroe by **E. E. Byrd,** acting district superintendent of the Means district in West Texas.

Jim Stephenson, assistant district superintendent at Friendswood district in the Gulf Coast division, was promoted to district superintendent at Hardin district. **W. W. Denyer,** assistant district superintendent at Anahuac transferred to Friendswood replacing Stephenson.

L. E. Rhodes, assistant district superintendent, has been made acting district superintendent of the Means district in West Texas, **R. M. Lilly,** assistant district superintendent at Hobbs district will replace Rhodes at Means.

Delma Baucum, district superintendent at Stanton district, West Texas division, was transferred to Wink district, and **C. K. Seaman, Jr.,** acting district superintendent at Wink moved to Stanton district.

J. L. Crittenden, district petroleum engineer, Means district, was promoted to supervising petroleum engineer in the West Texas division office. **B. K. Bevill,** district petroleum engineer, Stanton district, has moved to Means district to replace Crittenden.

C. D. Ehrhardt, Jr., senior petroleum engineer, Houston office, transferred to the Tomball district, Gulf Coast division, as district petroleum engineer.

G. C. Edgerton, district petroleum engineer, Talco district, East Texas division, has been assigned to the Stratton district, Southwest Texas division, replacing **E. S. Pennebacker, Jr.,** who was transferred to the Houston office as senior petroleum engineer.

F. D. Love, district chief clerk, Talco district, was promoted to assistant division chief clerk, East Texas division.

R. P. Trice, senior division clerk, East Texas division office, transferred to the Talco district as district chief clerk.

W. M. O'Reilly, petroleum engineer, Gulf Coast division office, has been assigned to the Houston office as senior petroleum engineer.

Edwin J. Stanley, civil engineer, Raccoon Bend district, Gulf Coast division, was named district civil engineer at the potash district, Louisiana division.

John C. Culberson, petroleum engineer, Grand Isle district, Louisiana division, was promoted to district petroleum engineer at the Potash district.

▸ **Jerome J. "Jerry" O'Brien,** formerly vice president of Monterey Oil Company of Texas, has been named president of Monterey Exploration Company with headquarters in San Antonio. The original Texas affiliate has been liquidated in conformity with a general reorganization and consolidation plan that has been in progress since Monterey Company took over the properties of Jergins Oil Company in 1952. Monterey Exploration is a wholly owned subsidiary of Monterey Oil and will have complete responsibility for the company's Mid-Continent operations.

SPECIFY THE LARKIN *All Purpose* FORGED STEEL TUBING HEAD

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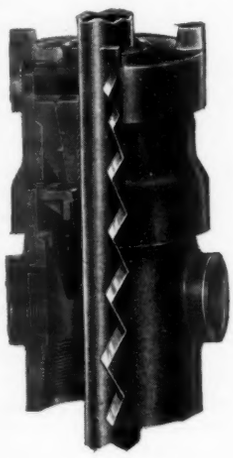

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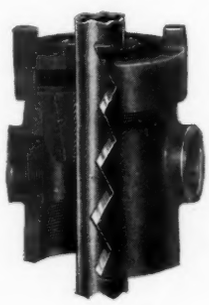

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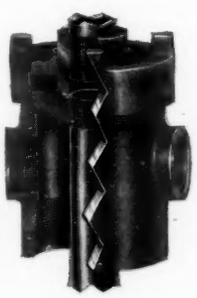

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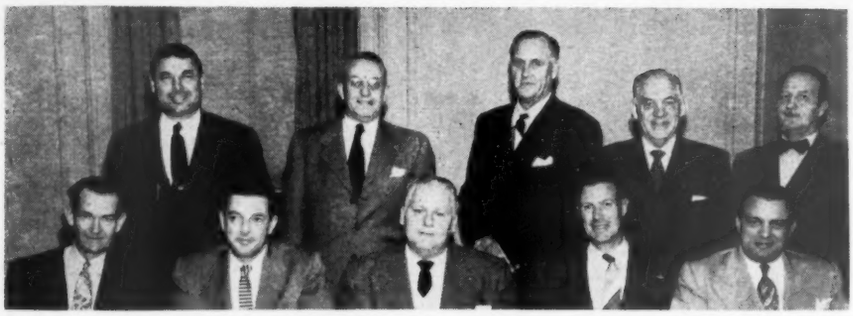


Officers of Los Angeles Nomads for 1953, together with the retiring officers are seated: Bob Craig, National Supply Company, treasurer; John Flanagan, Johnston Testers, Inc., vice president 53; Jim Hughes, Lane-Wells, president; Bill Wilson, Web Wilson Oil Tools, junior regent; Joe Schlarb, Chiksan Company, sergeant-at-arms. Standing: Ox Morgan, Oil Well Manufacturing, deputy sergeant-at-arms; Earle Boggess, Baker Oil Tools, Inc., senior regent, 1952; Jerry Engstrand, Western Geophysical, senior regent; Leo Cypher, Baash-Ross Oil Tool, assistant treasurer, and Wally Sawdon, executive secretary.

New York Nomad's guests at the Stork Club in New York City, February 2, 1953, included this group: Al Thomas, Petroleum Service and Supply, Maracaibo, Venezuela; Andy Duarte, Construcciones Industiales, S.A., Caracas; Walter Butler, Importadora Exportadora Robert Schasseur, Rio de Janeiro; J. W. Des Champs, Lucey Export, Buenos Aires; George Pope, and Gordon Morgan, Creole, Venezuela; W. W. McCune, Iraq Petroleum, Basrah, Iraq, and Samuel Schoelman, Petroleos Mexicanos, Mexico.

E. P. Hayes

E. P. Hayes, former chief petroleum engineer for The Texas Company, has been appointed chief petroleum engineer of the producing division of the California Texas Oil Company, Ltd. Hayes, who has an extended background as a petroleum engineer, was graduated from Case School of Applied Science.

After serving in an aviation unit in France in World War I, he went to Fort Worth, Texas, where in 1925 he became assistant engineer in charge of a helium plant for the Bureau of Mines. Hayes became affiliated with The Texas Company as petroleum engineer in the South Texas division in 1933.

Dr. John P. Buwalda, professor of geology at the California Institute of Technology, has received a Conservation Honor Award from the California Conservation Council. The award was presented to Dr. Buwalda for his effective work for the conservation of natural resources. Dr. Buwalda has worked continuously for the past 25 years with the National Park Service for the better use of national parks. A member of the board of expert advisers to the National Park Service, he later served on the Yosemite Advisory Committee. He received his bachelor's and Ph.D. degrees from the University of California.

William W. Clawson, of Billings, Montana, has been named president of Socony-Vacuum Exploration Company, an affiliate of Socony-Vacuum Oil Company, Inc., operating in Western Canada. **H. R. Moorman,** of Calgary, is executive vice president; and **Walton H. Hohag** and **L. C. Stevens,** both of Calgary, are vice presidents. These four men constitute the board of directors.

Other officers are: Harris E. McCombs, of Calgary, secretary; W. A. Work, of Calgary, assistant secretary; J. C. Thompson, of Billings, comptroller and treasurer; B. E. Taylor, of Calgary, assistant comptroller, and M. P. Rollick, of Calgary, assistant treasurer.

G. W. Hart, superintendent of measurement, has been appointed assistant manager of the gas department, General Petroleum Corporation. With General Petroleum since 1934, he has worked in gas plants at Athens, Santa Fe Springs, and Lebec.

A. L. Saulsbury has been named senior drilling foreman for the production department's southern division. With General Petroleum since 1916 on oil field drilling operations, he advances from his former post of Drilling Foreman at Wilmington.

E. V. Watts, named assistant to the director, General Petroleum Corporation, has been superintendent of the production department's Southern division since 1949.

B. H. Robinson has been appointed manager of field operations. He has been manager of joint venture operations since 1947. Succeeding Robinson as manager of joint venture operations is **D. G. Kingman,** assistant manager since mid-1952. Kingman was superintendent of the production department's San Joaquin division from 1945 to 1952.

Succeeding Watts as superintendent, Southern division, is **A. W. Titus.** He has been the division's production superintendent since 1950.

A. L. Hair has been named superintendent of the production department's Rocky Mountain division. Formerly drilling superintendent, Southern division, Hair will make his headquarters in Salt Lake City, Utah.

H. H. Carrick, formerly assistant to the superintendent of the Southern division, becomes production superintendent, Southern division.

O. H. Berry, Jr.

O. H. Berry, Jr., has joined Vickers Petroleum Corporation as chief engineer to supervise deep drilling operations. Berry, well known in the Midland, Texas, Permian Basin, resigned a post with the Wilshire Oil Company to join Vickers. Prior to this last position, Berry was division engineer with Standard Oil of Texas. He is a graduate of Texas A and M.

Berry will have headquarters in Oklahoma City and in addition to his duties as technical advisor, he will handle all of its reservoir appraisal work.

A Refinery as a Chemical Factory

Catalytic synthesis with superfractionation of a mixture of products is trend in new processes

ARCH L. FOSTER*

It is become axiomatic to observe that the present-day refining industry is progressing more and more rapidly into the realm of highly specialized product manufacture. Long gone are the days of "shotgun refining," when crude was run to stills, the products made were as the refiner wished, and the sales department had to sell what was made, rather willy nilly.

As of now the list of specialties is longer than that of what may be called standard products, although quantities involved may well be very small by comparison. The great majority of refiners are engaged in some phase of specialty production or segregation. These products include everything from liquefied petroleum gases and aromatics, to naphthenic acids and viscous-to-solid products from asphaltic residues, and embrace a great number of raw materials and/or intermediates for the petrochemical industry.

It is indicative of this trend, therefore when, last September, Cosden Oil Corporation began operation of Procon built Platformer-Udex unit, for the dual role of upgrading naphthas as motor and/or aviation fuel components, and of dehydrogenating - aromatizing lighter fractions to synthesize and isolate certain aromatics to meet the increasing demand for these products. This was not the first Platform-Udex unit to be put into operation; Eastern States Petroleum, at Houston, began one nearly a year before, utilizing the same process principles. The outstanding factor in the Cosden venture is that nitration grade benzene, toluene, and xylenes are being synthesized and segregated for the market, an activity never before carried out in this manner we are told.

Obviously the Cosden executive staff did a great deal of "research" before embarking on this project. They surveyed the market demand for all these products. The war situation complicates such investigations and it was necessary to evaluate the situation in the event of first, all-out war, and second, cessation of a fighting war. In the first event, a greatly expanded demand will occur for both motor fuel for ground forces, and for aromatics for two purposes, enrichment of "fighting grade" fuels for conventional reciprocating aviation engines, and for nitration to make explosives, best known of which is TNT, trinitrotoluene, in very wide use, militarily speaking. In addition much of the charge stock for aromatics synthesis is or may be used in jet fuels, a lustily growing youngster in the refined products family.

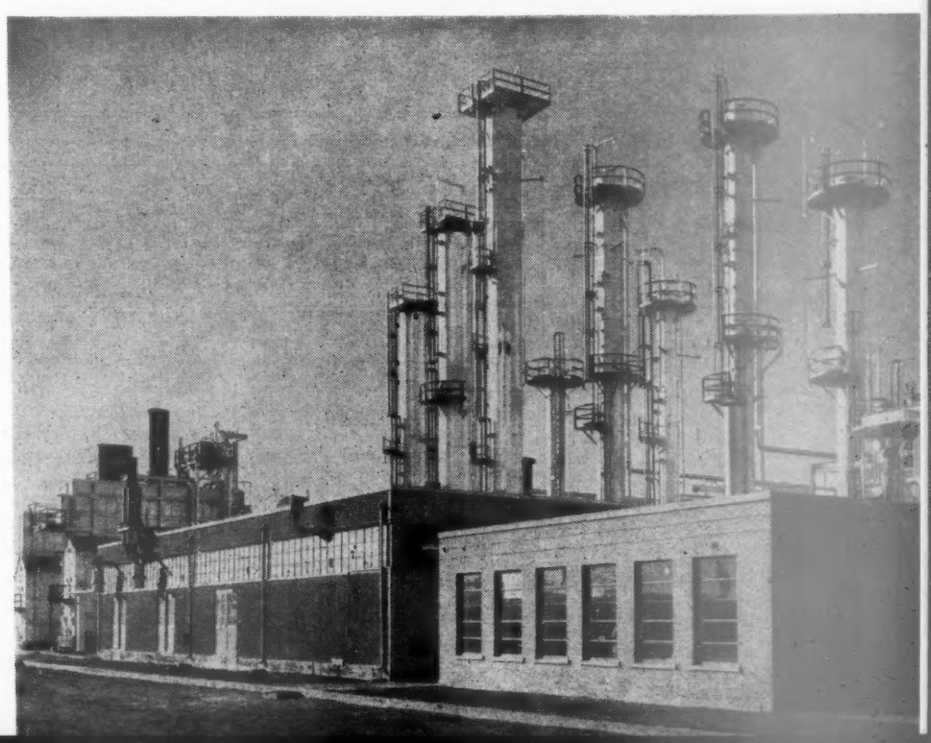
The Cosden company was already making and selling some specialties, including mercaptan as odorant for fuel gases. A relatively new fluid catalytic cracking unit was going full blast, but no facilities were at hand to do just what was wanted with naphtha of low octane rating, high sulfur. Decision was made to install a Platformer unit for the main conversion step, and a solvent extraction-fractionation combination unit to accomplish the segregation of the various specialty products. A set of conventional fractionator columns was installed to handle that last step and the Udex solvent extraction system was selected to do the initial concentration step.

Charge to the new system is prepared by taking off pentanes and lighter from the straightrun naphtha from the 30,000 bbl per day of West Texas crude, splitting bottoms, hexanes, and heavier, from the first column into two fractions, with the first boiling between 150 F and 270 F, the heavy one distilling between 270 F and 400 F. The Platformer unit operates on two separate schedules, and the time on stream for each is determined by the amount of charge made for each schedule. Prior to the removal of pentanes, etc., the sulfur is reduced from about 0.2 per cent to 0.02 or lower, in a conventional clay treater.

For production of improved motor fuel stock the heavy naphtha fraction is fed to the Platformer at 3500 bbl per day or more. Four catalyst chambers are employed. Temperatures, flow rates, etc., are maintained to yield approximately 95 per cent — on the charge — of motor fuel component with a leaded F-1 octane rating of 95 or slightly higher. The sulfur content of this product is essentially nil; the fraction goes to the refinery proper for blending into motor fuel.

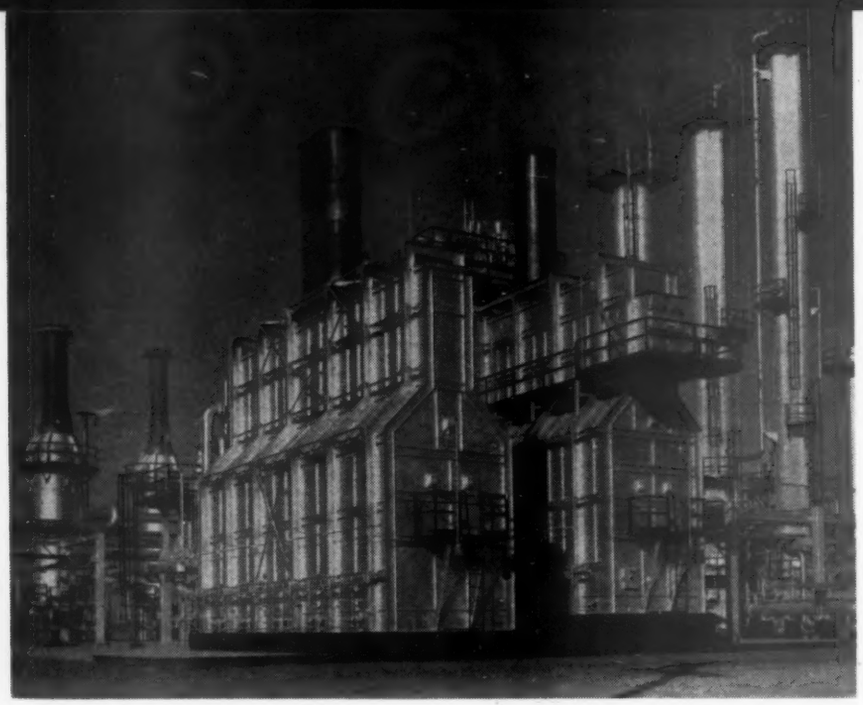
The unit is operated for motor fuel

Partial over-all view showing completely enclosed engine end of compressor house and control house in foreground.

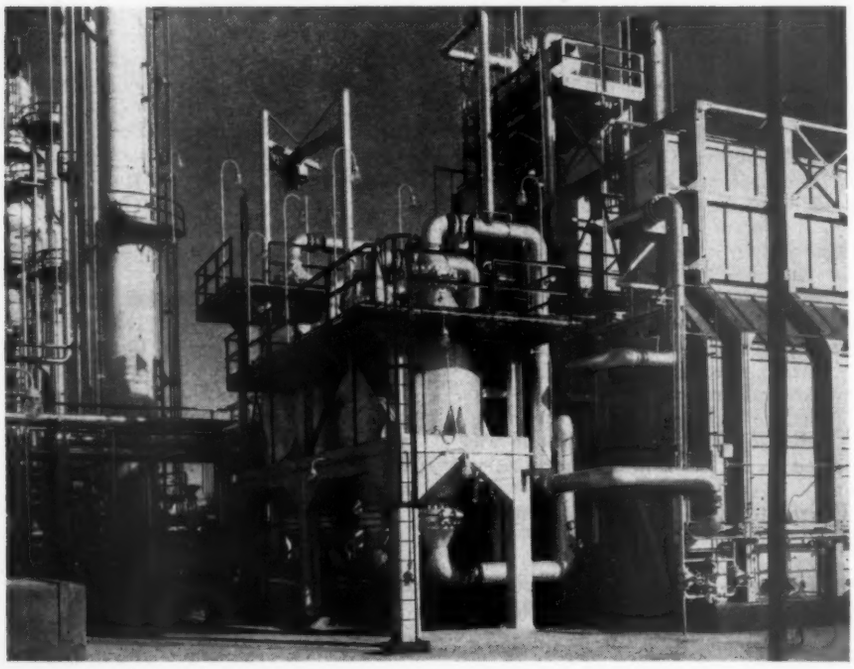


*Editor, Refining and Gas Processing.

EXCLUSIVE



Platforming unit heaters.



Platforming unit reactor section.

TABLE 1. Inspection of aromatic products from Udex unit.

	Benzene ASTM Nitration grade specs.	Udex product	Toluene ASTM Nitration grade specs	Udex product	Xylene ASTM Nitration grade specs.	Udex product
Specific gravity	0.8820—0.8860	0.8849	0.8690—0.8730	0.8724	0.8650—0.8700	0.8724
Color	†	Passes	†	Passes	†	Passes
Solidifying point, C	<4.85	5.49	.....	.....	.....	.....
Acid wash color						
Acid phase	<2	0	<2	0+	<6	0+
Hydrocarbon phase	No change	Passes	No change	Passes	No change	Passes
Acidity	No free acid	Passes	No free acid	Passes	No free acid	Passes
Sulfur compounds	Free of H_2S & SO_2	Passes	Free of H_2S & SO_2	Passes	Free of H_2S & SO_2	Passes
Sulfur, weight per cent	.....	.....	.....	....	.....	0.0008
Copper corrosion	‡	Passes	‡	Passes	‡	Passes
100 Ml. Distillation						
Range, C	<1	0.6	<1	1.0	<3	2.6
Included temperature, C	80.1	Passes	110.6±0.1	Passes	139.3	Passes
Initial boiling point	.....	79.8	.....	110.2	.....	139.0
10%	.....	80.0	.....	110.4	.....	139.2
50	.....	80.1	.....	110.8	.....	139.8
90		80.2		111.0		140.4
End point		80.4		111.2		141.6

† Not darker than solution 0.0030 g. $K_2Cr_2O_7$ in one liter of water.
‡ No iridescence or discoloration.

for a predetermined period of time, then is switched to aromatics production. The charge stock is the lighter of the two cuts from the pentane-free naphtha. Operating conditions are so changed that the maximum isomerization of cyclopentanes in this stock to yield cyclohexanes is accomplished. Next the 2000 to 2300 bbl per day of charge is dehydrogenated by the catalyst, always in the presence of hydrogen, to yield benzene, toluene, and the xylenes. Raw product is again depentanized to remove any pentanes and lighter formed during this operation, then sent to the Udex unit for separation. Total aromatics production from this operation is approximately 95 per cent of charge.

The Udex unit operates on a separate system, charging some 1600 bbl per day from floating roof storage where it is held out of contact with air. This stock is charged at about the middle of the extraction column in which it rises to meet a downflowing stream that contains diethylene glycol. This solvent dissolves the aromatics selectively and forms a separate layer from the portion which includes the paraffins and other non-aromatic constituents. The aromatics-carrying solvent stream enters a stripper column in which solvent and aromatic mixture product are separated and solvent returns to the absorption step in its cycle. The aromatic mixture goes to three columns from each of which a single aromatic-benzene, toluene, and lastly the xylenes, is segregated in nitration grade material, that is, containing only a small fraction of one per cent of impurities or material other than the substance wanted. In the xylene fraction the three isomeric xylenes, ortho-, meta-, and para-xylene, show typical proportions as follows:

Toluene ..... Less than 1 vol per cent
Para-xylene ... Less than 18 vol per cent
Meta-xylene ... Less than 39 vol per cent
Ortho-xylene . Less than 24 vol per cent
Ethylbenzene . Less than 19 vol per cent
Higher aromatics ..... NONE

Control of the entire Platformer-Udex system centers in a Panellit graphic panel, that includes 64 strip chart recorders to indicate and record each phase of the whole operation. One departure in the system is the use of air-cooled units instead of water exchanger-coolers, under conditions where the water side of the exchangers have shown serious fouling and thus difficulties.

The properties of the different products from this operation are shown in detail in the accompanying table at lower left.

Although the situation of each refiner varies in greater or less degree from that of any other, the diversification of operation and of product offered by new processes such as those described briefly here make for greater plant flexibility to meet the phenomenal growth of the petrochemical and the expanding refining industries. This short short story shows how one refiner is preparing his facilities for specialization to augment his production of "standard" refined products, to make of his refinery a chemical plant, as all of them are becoming. * * *

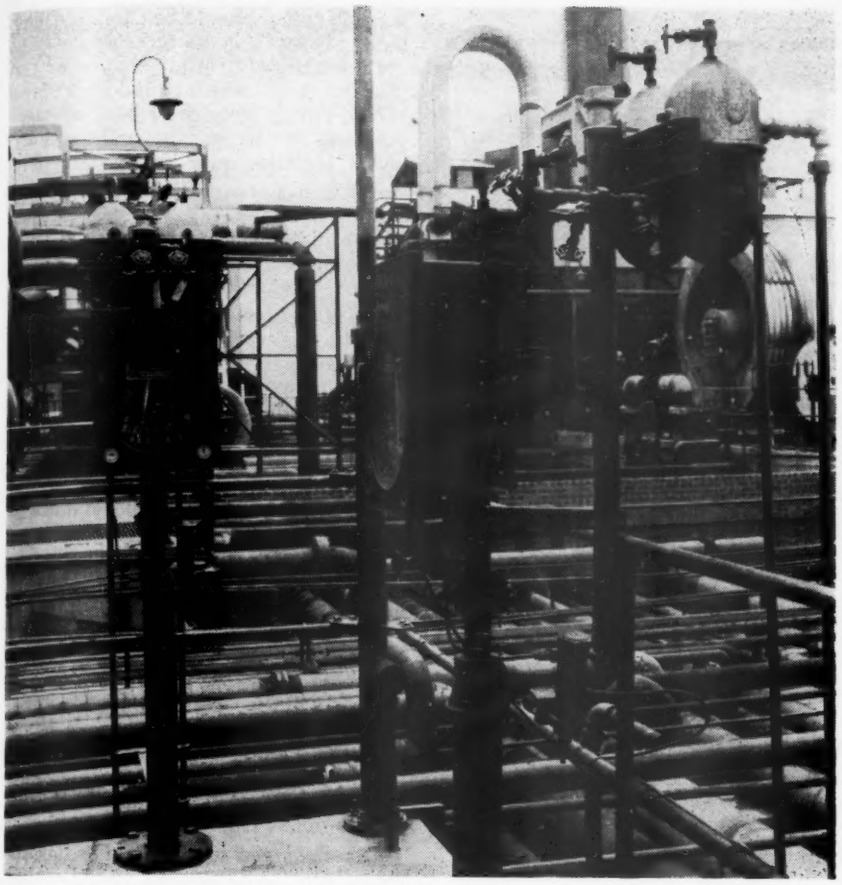


FIG. 1. Orifice meters in action at a large petroleum refinery.

TRENDS IN

Refinery Instrumentation

PART 8 — Installation and maintenance of orifice meters

S. D. ROSS* and J. PROCOPI*

PROBABLY no other instrument is as widely employed throughout the petroleum industry as the orifice meter. The accuracy of the records supplied by these meters, and the extent to which the capital investment in the instruments will be protected are determined by how much time and effort is expended in their maintenance. This maintenance activity should be delegated to individuals who have been properly trained in this class of instrument work. They alone should be permitted to make meter adjustments, as well as supervise installation.

The importance of correct meter installations can not be overemphasized. Too often the basic principles of complete and satisfactory installation are ignored, with resulting errors in meter readings. Care should be exercised in the installation of an orifice plate or other primary device, as well as in the fitting of connecting piping.

*Brown Instruments Division, Minneapolis-Honeywell Regulator Company.

EXCLUSIVE

Present day practice (where mercury meters are employed) involves the use of many varied piping arrangements in order to obtain satisfactory metering of corrosive, volatile or viscous fluids by use of sealing liquids, purging and other special systems.[1] All of these devices are located in the interconnecting piping and when properly installed and maintained, provide the means of solving a difficult metering problem. When they are improperly installed or maintained, however, the metering system is useless.

Installation of Orifice Plate and Piping

In installing an orifice plate, for example, there are several precautions that must be observed. First, the orifice must be installed in the proper direction with the sharp and square edge facing upstream. The plate must also be centered in the flange so that the orifice opening is concentric with the pipe. Gaskets used on each side of the plate should be cut and carefully positioned in order that they will not obstruct the opening.

Faulty installation of the taps is another source of metering errors. Most usually encountered are: (1) pipe tap nipple projecting beyond the inside wall of pipe into the stream, and (2) burrs left on the inside of pipe as a result of drilling and tapping operations. When the former situation is encountered, it is advisable to obtain sufficient thread surface either by welding a half coupling to the outside of the pipe or by building up the metal with a torch. Burrs can be removed by smoothing with fine emery cloth.

Straight Pipe Requirements. Related to the matter of proper installation of the orifice plate is the question of the length of straight pipe required on both sides of the primary element. Usually, a range of five pipe diameters is sufficient on the downstream side of an orifice plate. On the upstream side, the required length is a function of the orifice ratio and the types of fittings preceding it. The proper length for each piping layout can be determined by referring to available publications of the American Society of Mechanical Engineers Fluid Meter Committee.[2]

Connecting the Meter. The simplest and most satisfactory means of connecting the meter body with these flow line taps is by the use of ½-in. OD copper tubing and compression fittings, thereby eliminating troublesome joints. Where flow conditions preclude the use of copper, stainless steel tubing, either with compression fittings or pipe threads, can be employed.

In order to eliminate the possibility of trapping air in the connecting piping when a fluid is being measured, this tubing should slope downward toward the meter body at least one inch per foot. The grading should be maintained

[1] A discussion of these piping arrangements is contained in "Principles and Operation of Differential Fluid Meters" published by Minneapolis-Honeywell Regulator Company.

[2] An engineering aid to these calculations is "Flow Meter Engineering Handbook" published by Minneapolis-Honeywell Regulator Company.

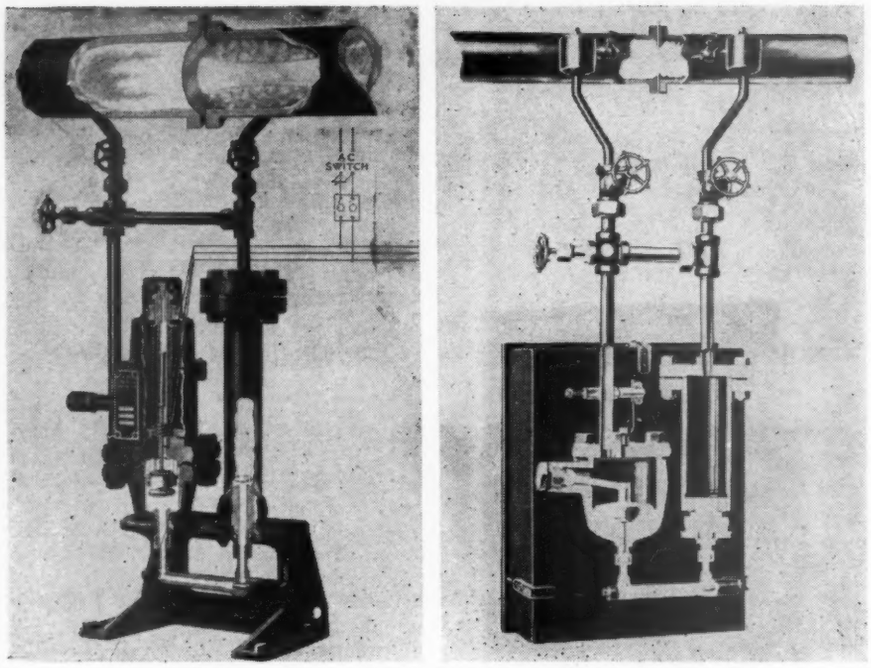


FIG. 2. Typical differential pressure "square-root" type electric flow meter (left) and mechanical type (right). Installation and maintenance practices recommended in this article apply to "square-root" type meter, both mechanical and electrical, as well as to the "linear" Ledoux bell meter.

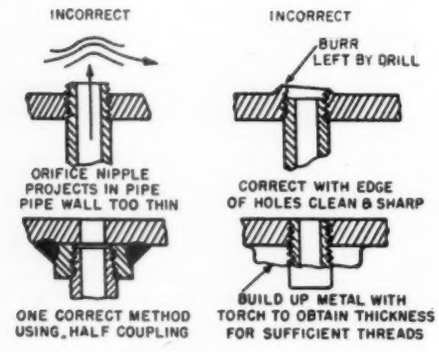

INCORRECT
ORIFICE NIPPLE PROJECTS IN PIPE
PIPE WALL TOO THIN
ONE CORRECT METHOD USING HALF COUPLING
INCORRECT
BURR LEFT BY DRILL
CORRECT WITH EDGE OF HOLES CLEAN & SHARP
BUILD UP METAL WITH TORCH TO OBTAIN THICKNESS FOR SUFFICIENT THREADS

FIG. 3. Correct and incorrect methods of installing taps.

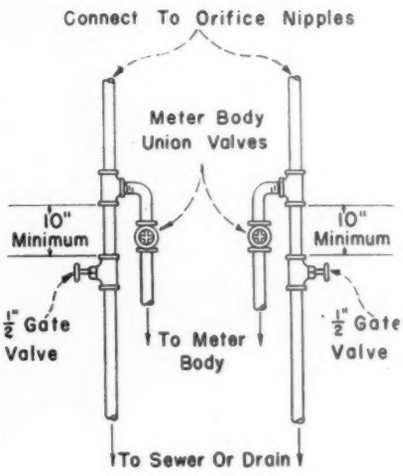


FIG. 4. Blow-down piping installation.

by firmly supporting the tubing, thus eliminating any possibility of sagging.

Union valves are especially useful for connecting the tubing to the meter, since they can be disconnected and screwed in the piping or the tube connectors. They also facilitate the blowing-down of orifice piping. Where blowdown must be effected at frequent intervals, permanent blow-off valves should be provided, as illustrated.

Maintenance of Orifice Plate and Piping

Operating conditions in the flow lines sometimes affect the shape of the orifice plate, causing meter errors. Fortunately, these conditions are not encountered frequently but when they do, are serious. The most common causes of orifice plate trouble are shown in Fig. 5. When the fluid being measured contains abrasives, rounding of the upstream edge oftentimes occurs, resulting in low meter readings. Wire drawing and warping of the plate can cause either low or high readings.

All of these conditions, with the exception of solids accumulation, necessitate the installation of a new orifice plate. The solids can usually be removed by means of a solvent. If the use of a solvent is impractical, or if the solids can not be dislodged by this means, a large flat stone should be employed, and then only on the plate face.

Piping System. Maintenance of the piping system (which includes all of the valves, fittings, condenser pots, and seal pots between the flow line and the meter body) includes periodic checking for:

(1) *Leaks at pipe connections, valves, and meter body joints.* The smallest leak will result in incorrect differential pressures on the meter body, with consequent errors in flow reading.

(2) *Levelness of condensers and seal pots.* Incorrect leveling produces errors, due to change in static head. Although this error can not be detected by normal zeroing (equalizing) of the meter body, it will exist and therefore precautions should be taken to eliminate it.

(3) *Clogging of connecting lines.* Connecting lines must be blown down to keep them free from clogging. The installation of auxiliary blowdown valves facilitates this work, thereby eliminating one source of sluggish meter operation.

(4) *Venting of piping.* On liquid installations, the connecting piping should be arranged so that it will be self-venting. The lines should be checked periodically to determine whether they are air or gas bound. High spots in the lines should be provided with suitable vents and should be regularly opened in order to release any trapped gases.

(5) *Drainage of piping.* On gas installations, the connecting piping should be self-draining, normally back to the flow line. The lines should be checked periodically for trapped liquids.

(6) *Contamination of sealing liquids.* On installations employing seal pots, periodic checks should be made to determine that the flowing fluid is not contaminating the sealing liquid. This test involves comparing a sample of the sealing fluid from the seal pot with a sample of unused sealing liquid. The seal pot test sample can be drawn at one of the various try-cock levels with both reference and test portions being collected in test tubes or clear glass bottles. Where contamination is present in the seal pot fluid, as determined by its physical appearance, both the seal pots and meter body should be cleaned and refilled with clean liquid.

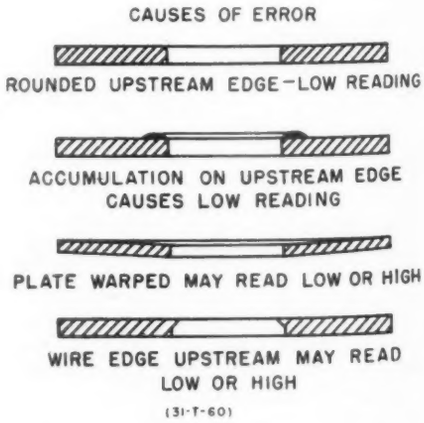

CAUSES OF ERROR
ROUNDED UPSTREAM EDGE—LOW READING
ACCUMULATION ON UPSTREAM EDGE CAUSES LOW READING
PLATE WARPED MAY READ LOW OR HIGH
WIRE EDGE UPSTREAM MAY READ LOW OR HIGH
(31-T-60)

FIG. 5. Orifice plate irregularities which cause erroneous readings.

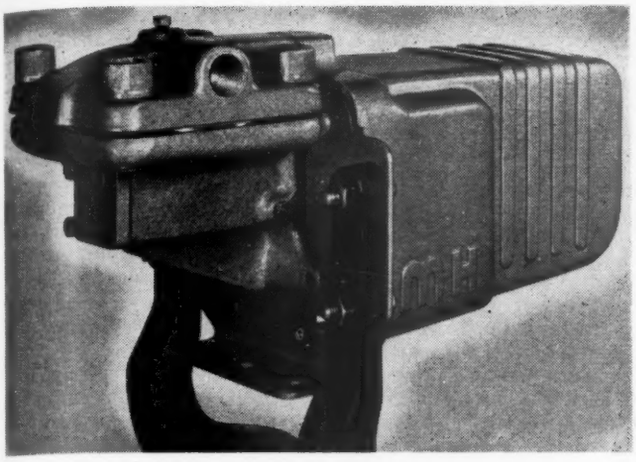


FIG. 6. Differential Converter, a mercuryless differential pressure transmitter.

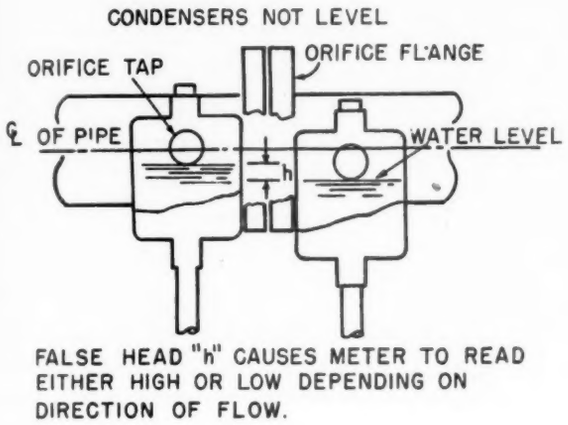

CONDENSERS NOT LEVEL
ORIFICE TAP
ORIFICE FLANGE
℄ OF PIPE
WATER LEVEL
h
FALSE HEAD "h" CAUSES METER TO READ EITHER HIGH OR LOW DEPENDING ON DIRECTION OF FLOW.

FIG. 7. Installation of condenser pots in steam metering with the mercury type meter. These pots are not required with the differential converter.

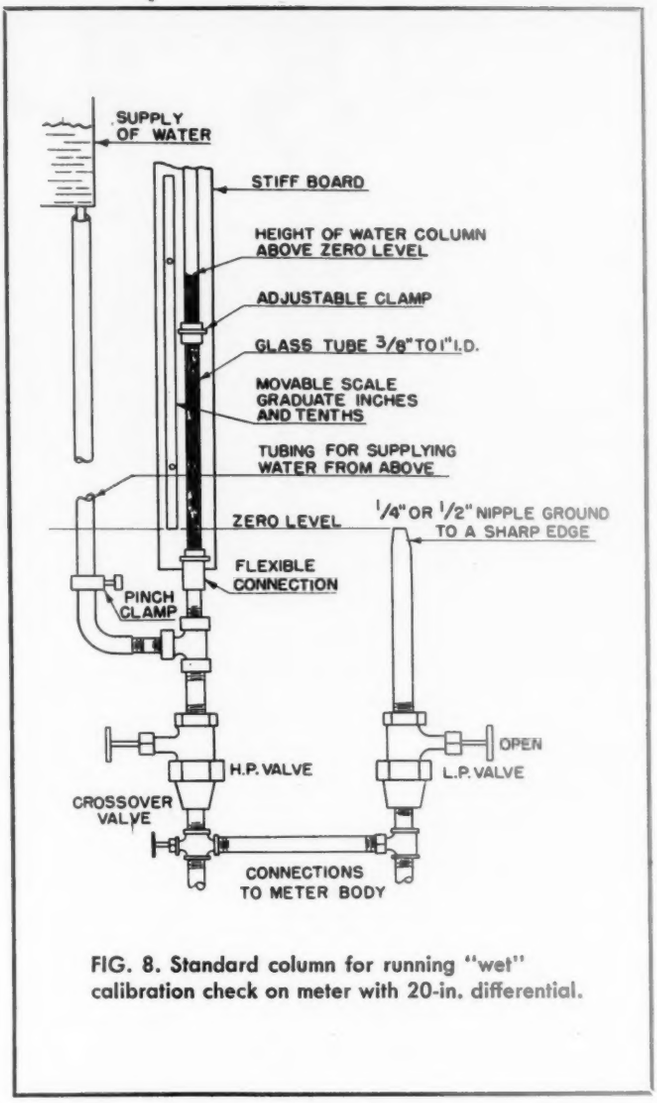


FIG. 8. Standard column for running "wet" calibration check on meter with 20-in. differential.

After the above maintenance has been performed, the instrument should not be checked for zero until sufficient time has elapsed to permit stabilization of the equipment at normal operating conditions. This "zeroing" procedure is described in the manufacturer's literature.[3]

Installation of the Mercury Meter Body

In steam measurement, when the mercury type meter is employed, condensate chambers must be provided in order to eliminate variations in the static liquid head which can result from the accumulation of condensate on the mercury. Where a mercuryless type meter, such as the *Differential Converter* is employed, however, this condensate produces no change in the static head, hence the need for condenser pots is eliminated.

Where the mercury meter is employed in steam measurement, however, condensate pots must be level (as illustrated), otherwise faulty readings will occur. It is also advisable to install the meter body below the orifice level, so that there will always be a positive head of water on both sides. When the meter must be installed above the orifice, piping arrangements should provide adequate and simple means for venting entrapped air from the line. This is accomplished by placing nipples and vent cocks at the highest point in the line. These recommendations also apply for measurement of liquids.

Gas and Corrosive Fluids. In gas measurement, if the gas or air is dry, the meter body can be located above or below the orifice plate. In either case, the orifice connections should be on top of the pipe. If the meter body must be located below the flow line, the orifice piping should extend upward six or eight feet, and then bend downward to the meter through a large radius, as illustrated. If the gas or air is moist, the meter body should be located above the flow line in order that condensate may drain into the flowing fluid.

The metering of corrosive gases and liquids requires the use of inert gas purges for the former, and sealing liquids or purges for the latter, in order to prevent corrosion of the meter body. A discussion of these systems is contained in a publication[1] previously mentioned.

Installation of the Differential Converter

When installing a Differential Converter, a location that is reasonably free of vibration should be selected. Ambient temperature should not rise above 225 F or fall below freezing.

Place the unit as close as possible to the orifice. Best performance is obtained when the Differential Converter is within 3 to 4 ft of the orifice. This eliminates long lengths of piping which may cause the meter to respond sluggishly. For steam or water measurements, the meter body should not be situated more than 100 ft from the orifice. For gas measurement, this distance should not exceed 50 ft.

Steam Measurement Installation

When measuring steam locate the unit below the orifice plate, with a slight slope of the connecting piping downward to the unit. The piping will then be self-venting. When the piping is filled, a certain amount of entrained gas or air is always present and when the system is placed under pressure, it will be forced into the flow line. Satisfactory results can be obtained with the unit located above the level of the orifice

[3]Instruction Manual published by Honeywell, contains installation and service instructions.

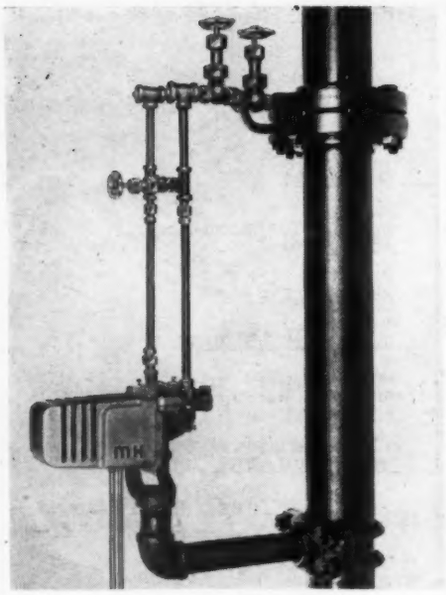


FIG. 9. Pipe saddle and yoke method of mounting Differential Converter for liquid or steam flow in vertical pipe line.

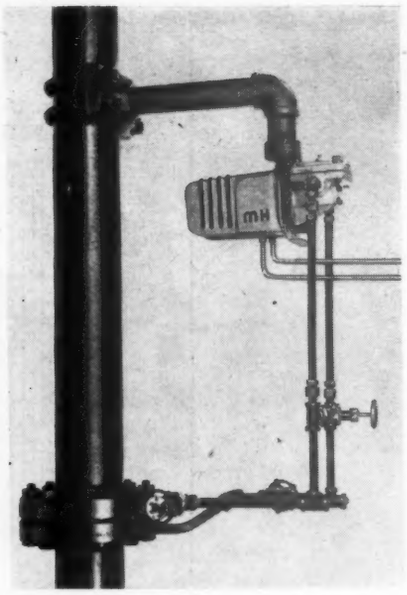


FIG. 10. Pipe saddle and yoke method of mounting Differential Converter for gas flow in a vertical pipe line.

plate, but the piping is more complicated.

On the steam installations, it is recommended that bent nipples be used at the orifice connections to help to maintain a constant head of water on the meter diaphragm.

Since the maximum displacement of the meter is approximately ¼ cu in., it is possible to produce, in a ½-in. pipe, a differential head error of ¾ of an inch; hence the need for bent pipe nipples. These nipples act as small condensers and minimize any errors owing to meter displacement.

Liquid Measurement Installation

The same recommendations apply for liquids as for steam. If the unit must be located above the flow line, suitable traps must be installed for segregation of any gas evolved. It will be necessary to vent these traps periodically to get satisfactory service from the meter.

Gas Measurement Installation

If the gas or air is dry, place the unit above or below the orifice plate. The orifice connections should be made on the top of the pipe. If the unit is located below the flow line, the orifice piping should be made on the top of the pipe and the piping should extend upward 6 or 8 feet, and then make a large radius bend down to the meter.

If the gas or air is moist, it is always best to locate the unit above the flow line in order that any condensation which may take place in the piping will drain back into the flow line. If the location must be below the level of the orifice, the installation of traps will effectively reduce the amount of liquid that will enter the meter body.

TABLE 1. Recommended flow meter maintenance schedule.

Item	Daily	Weekly	Monthly	Yearly
Ink pens	x	..	..	..
Check zero	..	x	..	..
Lubricate pressure tight bearing (mechanical)	..	x	..	..
Blow-down connecting piping	..	..	x	..
Check for leaks	..	..	x	..
Check sealing fluid	..	..	x	..
Check levels—seal pots, condensors, meter body	..	..	x	..
Check pen pressure on chart	..	..	x	..
Complete overhaul	..	..	..	x

Maintenance of the Mercury Meter Body

Periodic cleaning, checking and calibration of flow meters are requisites for consistent accuracy and long meter life. It is a well known fact that troublesome errors can result, for example, from scale or scum accumulation on the inside of a range tube, especially in the higher ranges.

The details of a periodic maintenance and calibration program for mercury meters (shown in Table 1) are covered in the manufacturer's literature.[3] Maintenance procedures[3] for the mercuryless type meter, the *Differential Converter*, are also available from the manufacturer.

☆ ☆ ☆

Research Project Initiated

Catalyst deactivation is the subject of a fundamental research project initiated by Armour Research Foundation of Illinois Institute of Technology. Program was announced by K. W. Miller, assistant director, research.

"Although great strides have been made in clarifying the mechanism of catalyst action," Miller said, "the fundamental changes in catalyst structure that cause or accompany deactivation of contact catalysts are not so well understood.

"We hope that application of X-ray and electron diffraction and other techniques will reveal clues."

Zero Check. The meter body should be equalized and checked on zero at least weekly. Any tendency of the zero to drift continuously up or downscale or to shift suddenly indicates some malfunction. This trouble may be caused by: Leakage; meter body not level; connecting piping faults; dirt in the meter body; and occasionally, contamination of the sealing fluid, where one is being used. If the trouble persists after the previously described checks on the connecting piping have been made, the meter body should be disconnected and cleaned.

Cleaning the Meter Body. Experience will usually determine the extent of cleaning required. When either silt, loose scale, or mud is found in the meter, thorough flushing with high pressure water will usually suffice. The meter body should be disconnected, the mercury drained and, if an electrical type meter, the power turned off and the leads disconnected. A high pressure water line should be connected to the low pressure side of the meter. Water should be permitted to flow through the meter until the effluent is clear.

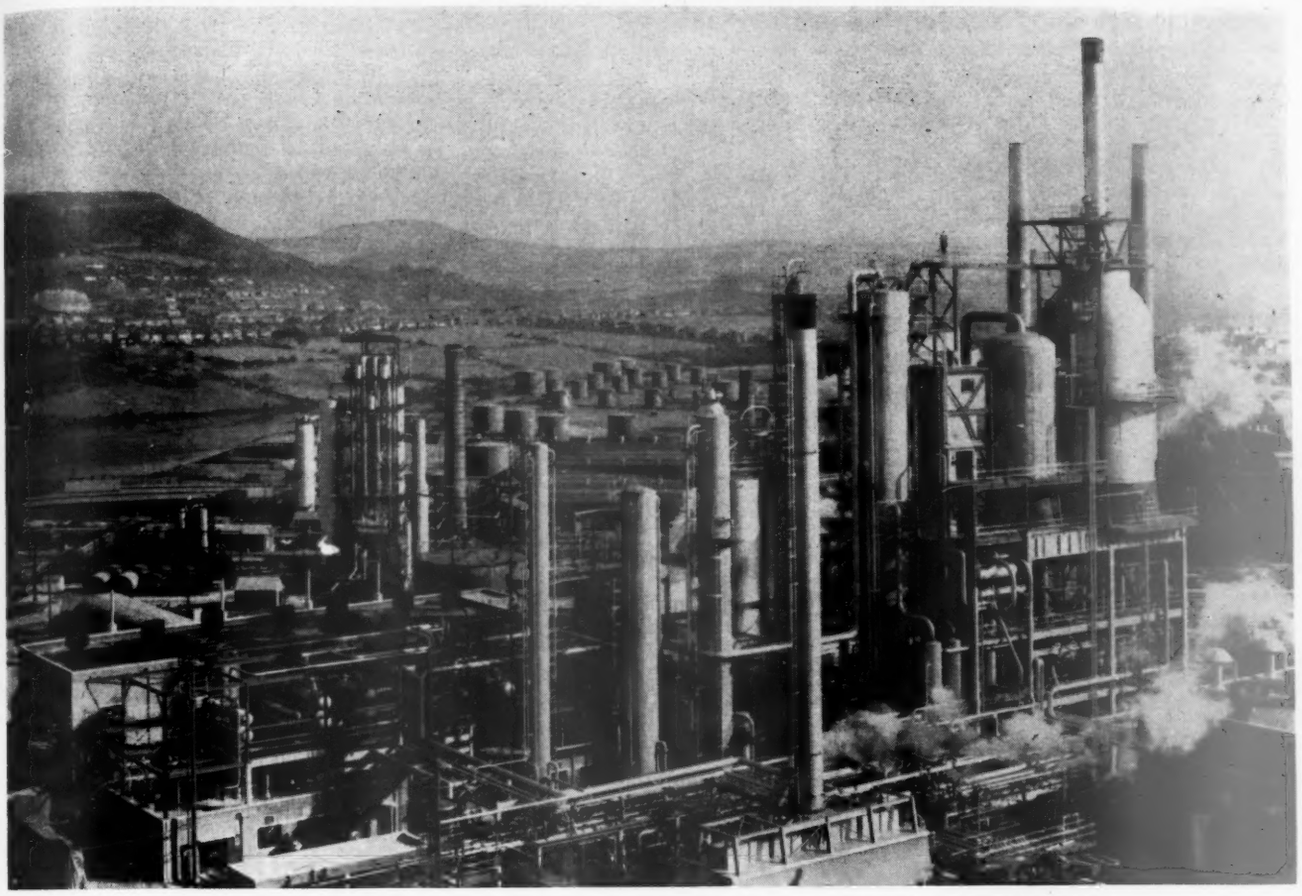
When the mercury is badly amalgamated, it should be replaced. If facilities are available, the mercury can be distilled or purified by washing with acid. Usually, however, satisfactory results can be obtained by washing the mercury with water and filtering it through a fine chamois cloth.

Calibration of the Mercury Meter. Calibration should be checked periodically. The meter body should be clean and a suitable standard check column must be available. The type of standard column used will depend upon the facilities available and upon the differential range of the meters being checked.

Fig. 8 illustrates an arrangement for use on meters with 20 in. of water differential and which are to be "wet" calibrated, i.e., with water in the meter above the mercury. In making the column, it is advisable to use ½-in. ID glass tubing in order to reduce meniscus effect and errors in reading.

The water supply tank is placed above the highest water column marking, with the filling line coming in below the zero level on the gage. Where possible, distilled water should be used. Care must be exercised when filling the system and the meter body so that any trapped air will be expelled. The actual method for performing a "wet" calibration is described in the manufacturer's literature.[3] This reference should also be checked to determine the preliminary steps that must be taken prior to calibrating the electric type meter body, in order to ensure that the transmitting and receiving armatures are in the correct position and that the instrument is in static balance. ★ ★ ★

Part 9 of this series of instrumentation will be published in an early issue.



General view of Anglo-Iranian's Llandarcy refinery, South Wales. It is now handling more than 28,000,000 bbl. per year. New catalytic cracking unit is in foreground.

Refinery Expansion in Eastern Hemisphere

Shutdown of oil activities in Iran following dispute with AIOC brought about increased throughputs outside country

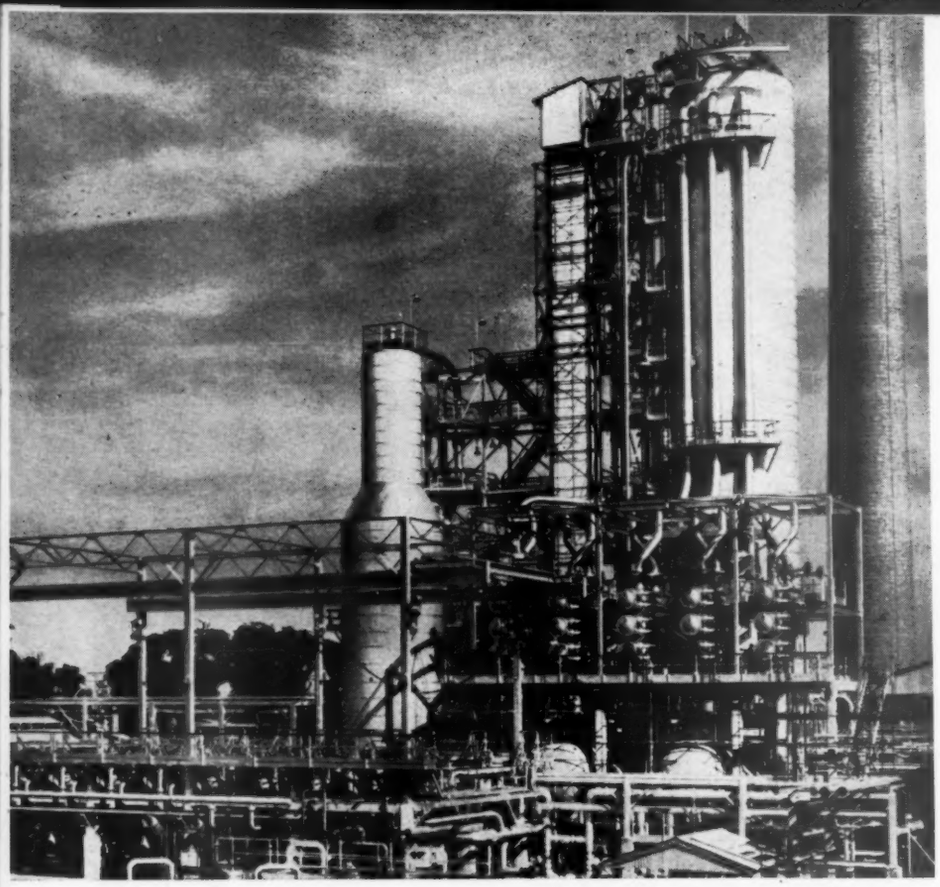
V. S. SWAMINATHAN

IN June 1951 a blow was struck which shook the world's oil industry. Then differences between the Government of Persia and the Anglo-Iranian Oil Company, Ltd., resulted in the shut-down of that country's production and refining. Iran was the oldest and largest producer in the Middle East and the third largest in the non-Communist world. During the first half of 1951 its crude output, of approximately 660,000 bbl per day, represented nearly a third of all Middle East output. Iran was then exporting 150,000 bbl per day of crude to the world's markets, but the bulk of its production fed the great Abadan refinery, whose daily shipments of finished products came to 460,000 bbl. Largest of the world's refineries, Abadan alone accounted for more than a fifth of all petroleum products refined in the free countries of the Eastern Hemisphere.

It is a glowing tribute both to the resourcefulness and flexibility of the world oil industry that the acute supply problems occasioned by the cessation of shipments of crude and products from Persia were so successfully faced. Industry committees formed under government *aegis* worked on these pressing problems in America, Britain, and elsewhere, and oil companies on both sides of the Atlantic rose to the occasion.

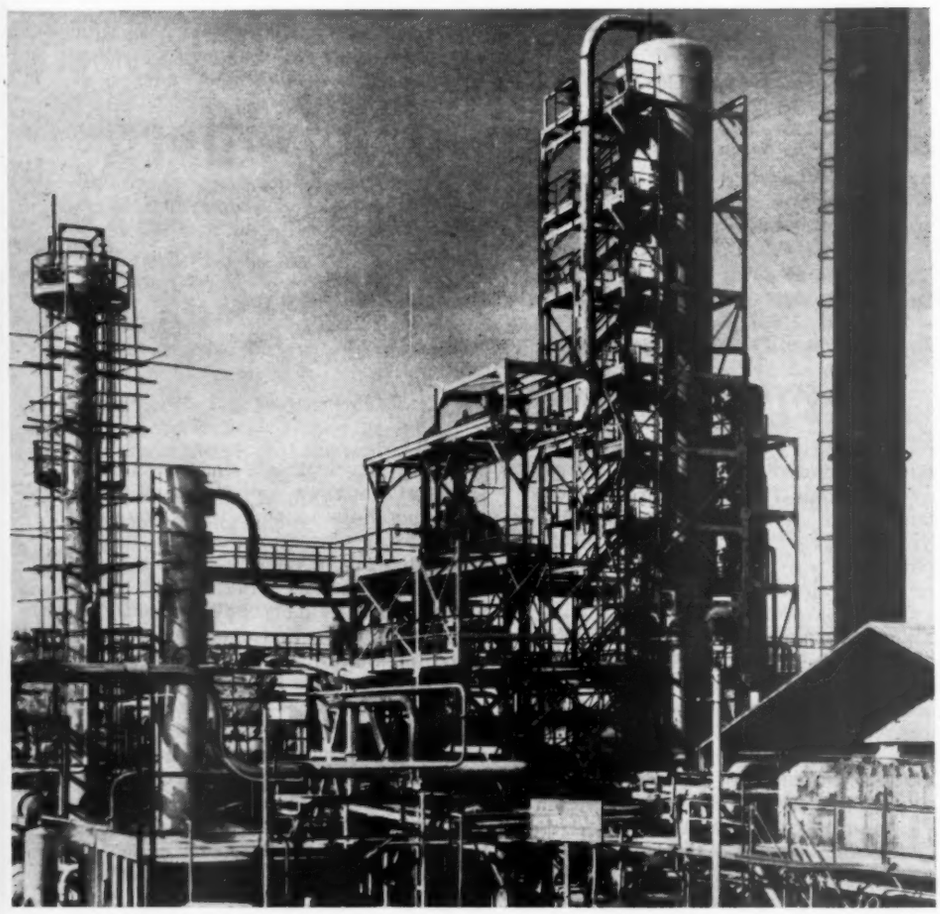
Since the end of the Second World War and more particularly following the Persian deadlock, there have been arresting developments in the Anglo-Iranian Company's widespread interests and operations outside that country. Since, for a start, products most in demand, apart from aviation gasoline, were fuel oil and gas oil, virtually every other of the group's refinery was able to force distillation units and modify, or convert, cracking plants and thermal reformers to serve as distillation units to squeeze extra capacity. Thus intensive and successful efforts were made to increase throughputs at the various installations outside Iran, and urgent consideration was accorded to the erection of further new refineries. Anglo-Iranian has built, or is building 16 refineries outside Persia. By 1955 its overall refining capacity of 224,000,000 bbl a year

EXCLUSIVE



Distilling unit for Kent refinery Isle of Grain, Great Britain, the largest in Europe, is nearing completion. One of the plants of Anglo-Iranian, the Kent distillation unit has a capacity of 28,000,000 bbl of crude oil a year.

Crude distillation unit of L'Avera refinery, France.



will have nearly reached the 228,000,000 bbl per annum peak just before the close down of Abadan.

Refineries associated with the Anglo-Iranian group are: National Oil Refineries, Llandarcy, South Wales; Scottish Oils, Ltd., at Grangemouth and Pumpherston adjoining that site, and Kent Oil Refinery (all in Great Britain); L'Avera and Dunkirk in France; Antwerp in Belgium; Hamburg and the Schwindler group in Germany, Marghera in Italy; Haifa in Palestine; Alwand in Iraq; Kuwait in that Sheikhdom, and Laverton in Australia. The company is also erecting two new large refineries at Aden in Arabia, and Kwinana in Western Australia.

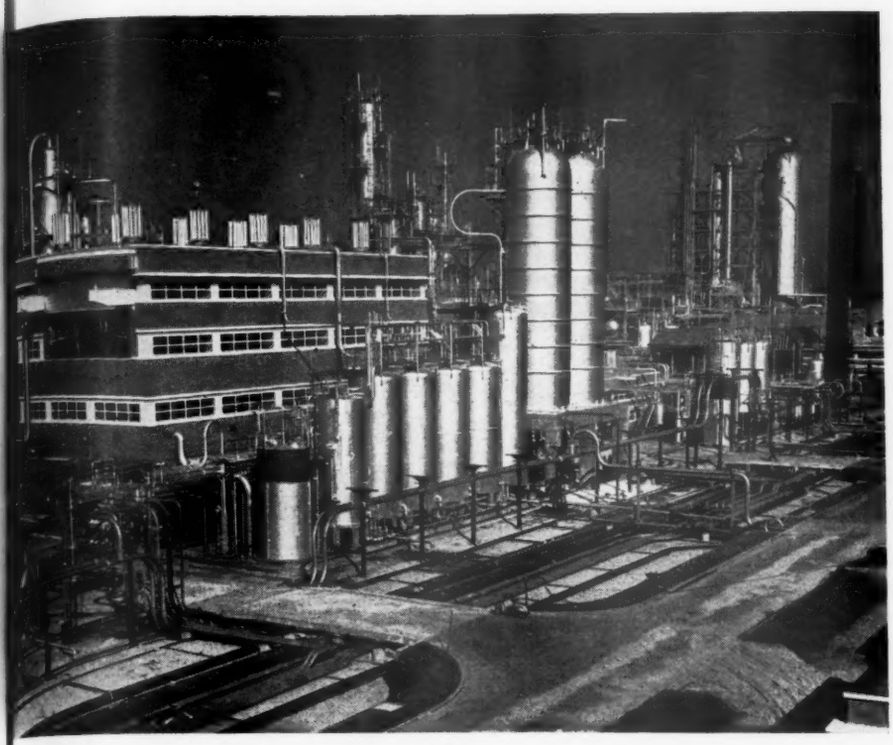
In U. K. complete new refineries are nearing completion in and around the sites of the old at Llandarcy and Grangemouth. In both cases new power stations and boiler batteries are being provided, and entirely new and separate cooling water circulating systems and docks with trans-shipment facilities. Before the second World War Llandarcy treated 2,800,000 bbl of crude oil a year. Now its annual throughput is nearly 28,000,000 bbl. This 10-fold expansion was accomplished by running the original main crude oil distillation unit rated at 7700 bbl per day at 12,950 bbl daily, by converting two cracking units to crude distillation units to process 15,400 bbl per day between them; by continuing to operate an old shell distillation unit rated at 550 tons per day, and by pushing the new unit rated at 42,000 to 49,000 bbl per day. It was found that the treatment plants had extra capacity, and only one new acid washery for motor spirit has so far been constructed.

The Grangemouth refinery, which had a pre-war annual throughput of 2,555,000 bbl, is now operating at 15,750,000 bbl a year. This increase was brought about by continuing to operate the original shell still distillation units at 7000 bbl per day, by converting two cracking plants to distill 14,000 bbl per day, between them, by pushing the new distillation unit rated at 26,250 to 30,450 bbl per day. The power station and boiler battery came into service last April.

At Pumpherston refinery, operating on Scottish shale-oil and crude petroleum produced in the United Kingdom, the throughput was 1,043,000 bbl. Detergents produced at this plant are finding an increasing market, and new products are being developed.

The British Petroleum Chemicals (BPC), Ltd., plant at Grangemouth, in which the Anglo-Iranian are partners with The Distillers Company, Ltd., began production of commercial alcohol in May 1951. The neighboring plant of Forth Chemicals, Ltd., jointly owned by the BPC and Monsanto Chemicals, Ltd., now under construction, is expected to commence manufacture of styrene before the end of 1952.

Good progress is being made with the Kent refinery, which began operations at half its eventual 28,000,000 tons per annum capacity during the fall of 1952. Catalytic cracking units for the production of high-grade motor spirit are be-



Dunkirk refinery, France, as seen in 1952.

ing installed at the Kent, Grangemouth, and Llandarcy refineries.

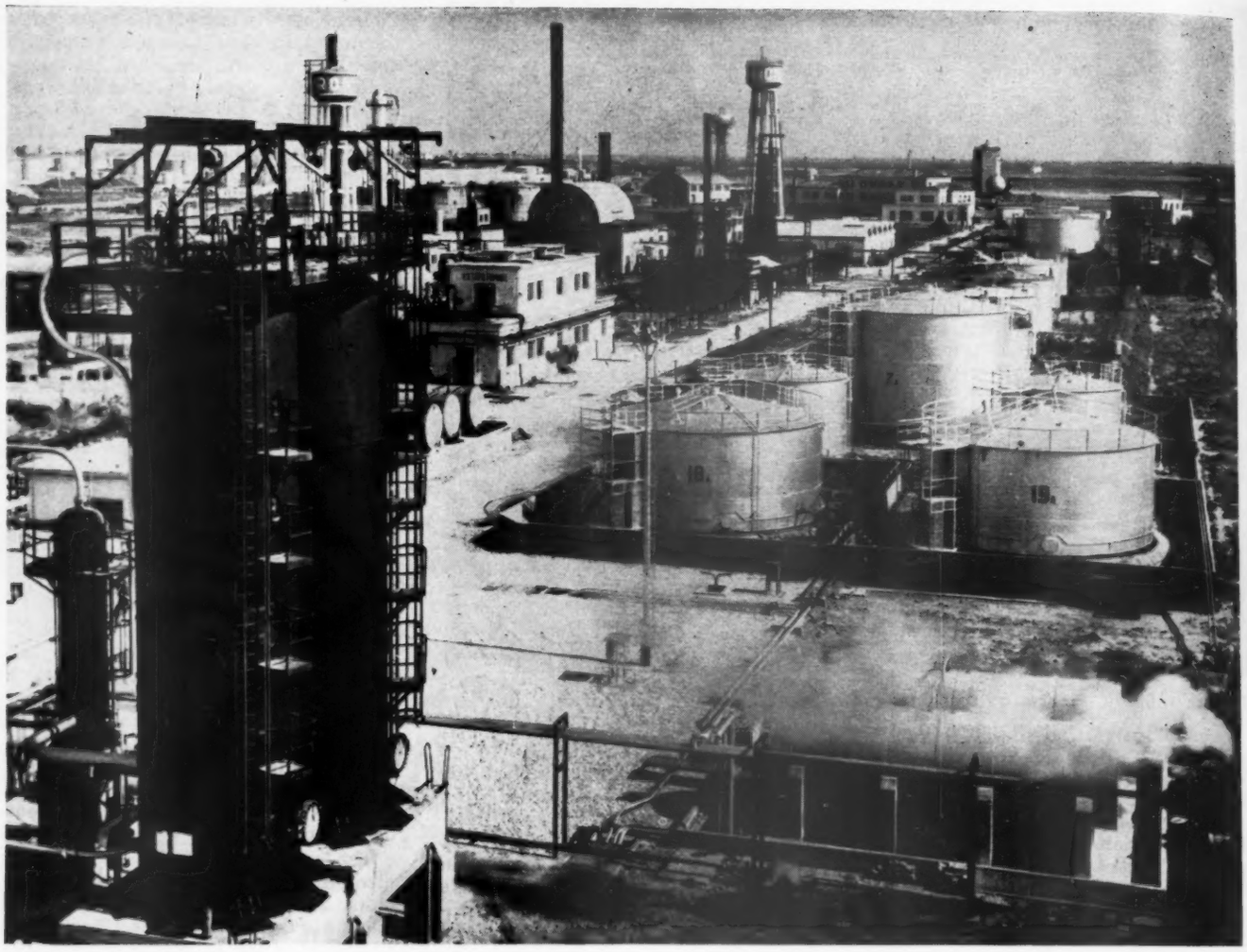
L'Avera refinery, owned by SGHP, French associate of the AIOC, and situated on Lake Berre, 30 miles from Marseilles, was built in 1932, the main contractor being M. W. Kellog Company, and designed for a throughput of 2,800,000 bbl a year. Without any major additions this plant is now treating 12,600,000 bbl of crude oil per annum. The original distillation unit, rated at 11,200 bbl per day by its designers, is processing 15,400 bbl per day. The cracking plant is distilling 12,600 bbl per day of crude, and the vacuum distillation unit 11,200 bbl per day, and it will do 15,400 bbl per day pending installation of an extra flash column. The original treatment plants have been sub-divided so that there are six banks of treaters in place of two, and one extra chloride sweetener has been erected out of salvaged vessels from the destroyed and written-off refinery at Courchelettes. The steam, power, and water services has had very little extension, and only a few extra storage tanks have been provided as new.

Dunkirk, also operated by SGHP, is a new plant, first commissioned in October 1951. The smaller of the two crude distillation units was salvaged from the Courchelettes refinery. The main contractors were The Lummus Company and their French associates. Materials for construction came from the following areas: USA 20 per cent, France 75 per cent, and U. K. 5 per cent. The smaller of the two distillation units previously rated at 900 tons per day is now being operated at 14,800 bbl per day, and the larger one designed for 23,800 bbl per day is now distilling 38,500 bbl daily. These two units have a capacity of 40,000 bbl per day, or 2,000,000 tons a year. The catalytic reformer will account for 6000 bbl per day, or 1,750,000 bbl a year. The lube oil plant is producing 420,000 bbl of high grade lubricating oils yearly. Electricity is generated in a refinery power station employing back-pressure turbines taking steam at 900 psig, and exhausting into the refinery mains at 175 psig. The company has also built a new jetty in Dunkirk Harbour, capable of accommodating two of the most modern super-tankers.

The Antwerp refinery, operated by SIBP, an association of Petrofina, Ltd., and Anglo-Iranian formed in 1948, represents a brand new project. The main contractors were The M. W. Kellogg Company, responsible for all process plant and the refinery generally, but the boiler plant, power station and electricity distribution system were developed in Britain. Here also pass-out turbines were used, but with very limited condensing capacity.

The refining plant consists of crude distillation, cracking, and reforming units, as well as the usual treatment plant, but there is no lube oil line. Commissioned at the beginning of October, 1951, the crude distillation unit is operating at its full design capacity of 28,000 bbl per day. The cracking plant is not commissioned as such, but as a crude unit of approximately 9800 bbl per day; and the minimum net result is that a refinery rated at 9,240,000 bbl a year

Antwerp refinery, Belgium at night with lights of Antwerp city in the background.



General view of refinery at Porto Marghera, Venice.

will process 12,609,000 bbl. The services and treatment plants are adequate to cope with this throughput, with minor adjusements.

The capacity of the Hamburg refinery, operated by B. P. Hamburg, a wholly-owned subsidiary of the Anglo-Iranian, is being enlarged; the principal addition being a crude distillation unit by Foster Wheeler. As regards materials used, 95 per cent is German and 5 per cent British. Electricity is taken from the Hamburg State-Grid, but steam is generated in a refinery boiler battery. The original combination crude distillation and cracking unit is now operating at 8400 bbl per day, and should go up further following installation of extra heat exchangers.

The Schwindler group consists of two small refineries at Neuhof in Hamburg and Peine near Hanover, both virtually wholly-owned subsidiaries of the Anglo-Iranian. The former accounts mainly for high-grade lube oils, and the latter, industrial oils and greases. Throughput of the Neuhof refinery is being stepped up from 840,000 tons a year to 1,400,000 bbl in 1953.

The Marghera refinery in Italy is operated by IROM, a joint company owned by AGIP and the Anglo-Iranian. The new plant is being added to the existing refinery, thus doubling its capacity. The original distillation unit rated 10,500 bbl per day, is doing 12,600 bbl daily; a re-distillation unit is processing crude at 1750 bbl per day for 20 days of the month, and schemes are under way to convert a coking plant to a distillation unit. The new distillation unit is rated at 10,500 bbl per day, but more than this capacity is hoped to be obtained from it. The material for the new plant is 60 per cent U. K., 30 per cent U. S. and 10 per cent Italian. This refinery produces gasoline, kerosine, gas, and fuel oils and minor amounts of industrial lube and transformer oils.

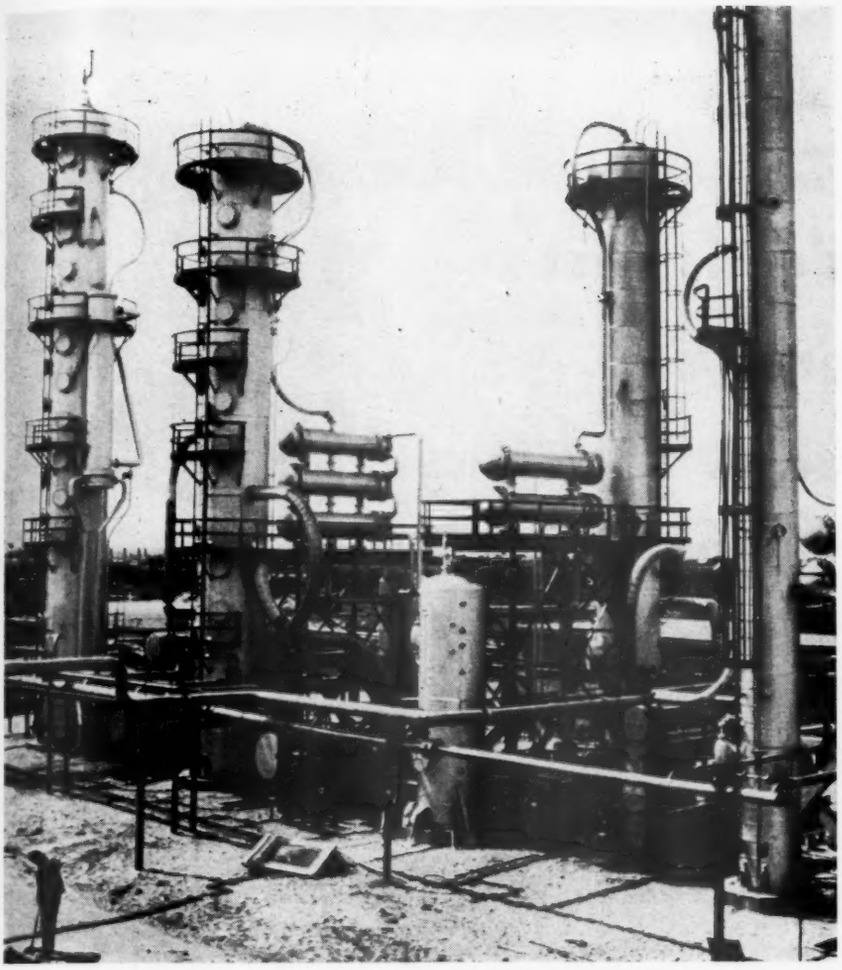
Electric power is generated in the refinery by two 1000-kw 50-cycle diesel-driven generators, two 215-kw 50 cycle diesel-driven generators, and one 110-kw 42-cycle generator. Some power is also supplied by the Italian state-owned electricity authority at 42 cycles, and converted to a 50 cycle supply. The boilers consist of two batteries, each containing two Babcock and Wilcox and two Scotch marine boilers. Water is drawn from a convenient canal.

To sum up, the European refinery expansion associated with the Anglo-Iranian group: current annual throughput at L'Avera is 14,000,000 bbl; at Dunkirk a similar figure; at Antwerp 10,500,000 bbl in 1952; at Porto Marghera 8,400,000 bbl this year; at Eurotank 4,340,000 bbl, and Schindler, Hamburg. 1,050,000 bbl.

In Iraq the Alwand refinery processed 3,010,000 bbl in 1951, an increase of 32,200 bbl on the previous year. The throughput of the Haifa refinery last year (1951) was 5,103,000 bbl, mainly of Venezuelan crude. It is still impossible to operate this plant at its full capacity of 28,000,000 bbl a year on Iraq crude oil for which it was designed. The Kuwait topping plant, the prime purpose of which is to produce bunker fuel for tankers, treated 8,099,000 bbl of crude in 1951.

Late last August J. M. Pattinson flew to Aden to discuss with the Governor and other members of that Protectorate Anglo-Iranian's plan to erect a 35,000,000 bbl a year refinery there. This refinery, entailing a capital expenditure of between $112,000,000 and $140,000,000, would take about two years to build, and would provide refined products to markets in the Red Sea, East and South Africa. The bulk of its output would be taken up in providing fuel oil for the ships' bunkering trade at Aden.

Aden is on the direct route from the company's Persian Gulf sources of supply to the African and Red Sea markets. Absorption of a considerable part of the refinery's output in the port's bunkering trade would mean economy in



Hamburg refinery, showing gas recovery plant looking west from atmosphere tower of Winkler-Koch plant.

tanker transport, as this quantity would not require re-shipment. The site of the refinery is at "Little Aden," six miles across the bay west of Aden town. Sufficient good building land is available, fresh water is to be had at an economic distance and a sea channel can be dredged and jetties built to accommodate the largest tankers now afloat. The company's existing bunkering installations at Aden could conveniently be supplied by a short pipe line around the bay.

Turning to the antipodes, following Western Australian Parliament's ratification of the agreement between the State Government and the Anglo-Iranian to build a new refinery at Kwinana, further details pertaining to this project are now to hand. The scheme is for the construction of a refinery with an annual throughput of 21,000,000 bbl at a cost of about $1,120,000. When this, the largest Australian refinery, is in full production it will meet the needs of Anglo-Iranian's Australian associates—the Commonwealth Oil Refineries Ltd., and the B. P. Company of New Zealand. It will, moreover, provide for Anglo-Iranian's Australian bunkering trade through B. P. (Australia) Ltd. Concurrently, storage and distribution facilities of the Commonwealth Oil Refineries are to be stepped up.

The Kwinana plant will comprise atmospheric and vacuum distillation units with the usual accompanying treatment plants. A catalytic cat cracker will enable high-grade petrol to be produced. The new refinery will require about 500,000 lb of steam and 5,000,000 gal of sea water for cooling purposes every hour. A power house, maintenance workshops, stores, and laboratory, equipped with test engines for product control, are to be built. Steel requirements for the project are placed at 80,000 tons, of which 20,000 tons will consist of piping of various sizes up to 60-in. diameter. Other materials needed will amount approximately to 150,000 tons.

The Western Australian Government has undertaken to make the necessary land available, supply fresh water and electricity, lay roads and railways to the site; carry out the needed dredging of the water channel through the Success and Parmelia banks to provide easy access for the biggest tankers, and build some 1000 houses for future employees.

The AIOC recently announced plans to set up five UOP platforming units, two to be erected in the UK, one in Europe, one in the Aden area and the fifth in Australia. Four of these units will have a design capacity of 6000 bbl per day, and the fifth 12,000 bbl per day. The Universal Oil Products Company has already begun engineering and design work on these five units. * * *

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with PLATFORMING-UDEX

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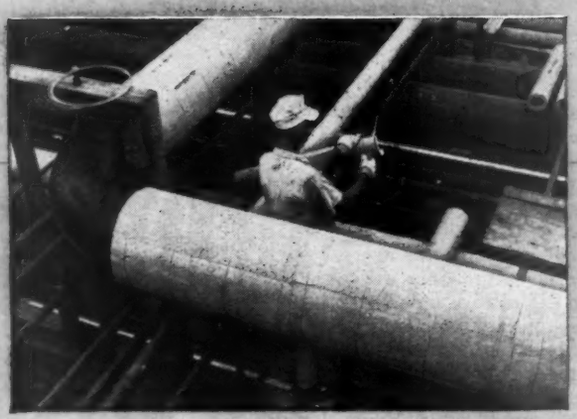

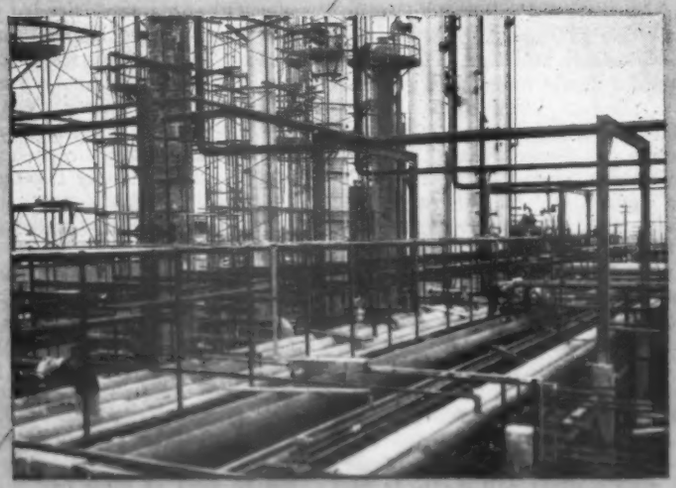

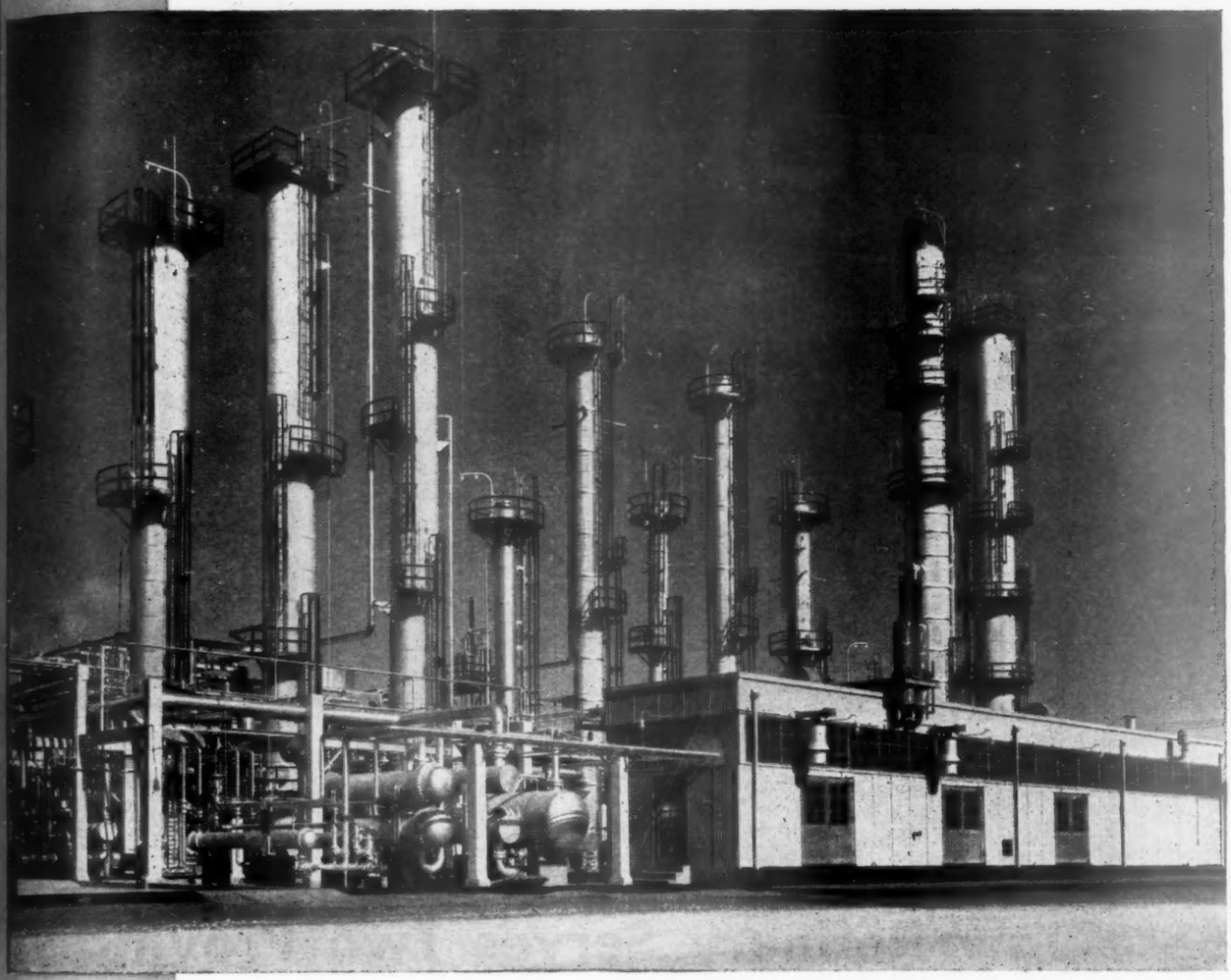

Completed by Procon in 11 months, the Platforming-Udex installation at the Big Spring, Texas, refinery of Cosden Petroleum Corporation is the **first** to produce all three aromatics — benzene, toluene, and xylene — plus a high octane motor fuel blending component.

Handling a charge of approximately 4500 barrels per day, the new facilities include a feed preparation section, a UOP Platforming Unit, a Udex unit, and a super-fractionation section. In addition, Procon also built accessory processing equipment, roadways, buildings, and utilities. All work was handled with maximum dispatch, and labor costs for the completed job were considerably below pre-construction estimates.

The successful and economical completion of this new plant is typical of Procon service on large and small construction projects for petroleum refiners throughout the world.

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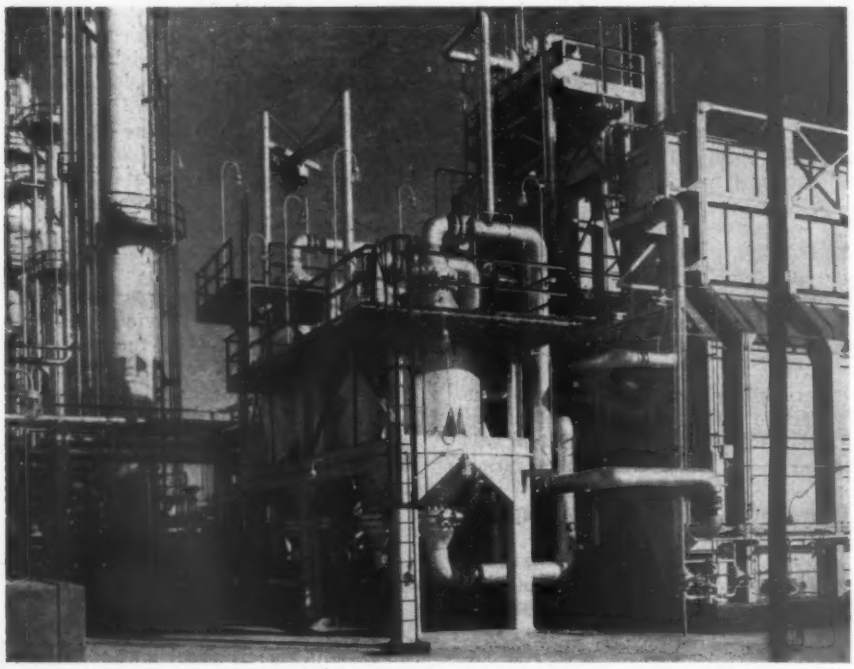
Platforming unit heaters.



Platforming unit reactor section.

TABLE 1. Inspection of aromatic products from Udex unit.

	Benzene ASTM Nitration grade specs.	Udex product	Toluene ASTM Nitration grade specs	Udex product	Xylene ASTM Nitration grade specs.	Udex product
Specific gravity	0.8820—0.8860	0.8849	0.8690—0.8730	0.8724	0.8650—0.8700	0.8724
Color	†	Passes	†	Passes	†	Passes
Solidifying point, C.	<4.85	5.49	.....	.....	.....	.....
Acid wash color						
Acid phase	<2	0	<2	0+	<6	0+
Hydrocarbon phase	No change	Passes	No change	Passes	No change	Passes
Acidity	No free acid	Passes	No free acid	Passes	No free acid	Passes
Sulfur compounds	Free of H_2S & SO_2	Passes	Free of H_2S & SO_2	Passes	Free of H_2S & SO_2	Passes
Sulfur, weight per cent	.....	.....	.....	.....	.....	0.0008
Copper corrosion	‡	Passes	‡	Passes	‡	Passes
100 Ml. Distillation						
Range, C.	<1	0.6	<1	1.0	<3	2.6
Included temperature, C.	80.1	Passes	110.6±0.1	Passes	139.3	Passes
Initial boiling point	.....	79.8	.....	110.2	.....	139.0
10%	.....	80.0	.....	110.4	.....	139.2
50	.....	80.1	.....	110.8	.....	139.8
90		80.2		111.0		140.4
End point		80.4		111.2		141.6

† Not darker than solution 0.0030 g. $K_2Cr_2O_7$ in one liter of water.
‡ No iridescence or discoloration.

for a predetermined period of time, then is switched to aromatics production. The charge stock is the lighter of the two cuts from the pentane-free naphtha. Operating conditions are so changed that the maximum isomerization of cyclopentanes in this stock to yield cyclohexanes is accomplished. Next the 2000 to 2300 bbl per day of charge is dehydrogenated by the catalyst, always in the presence of hydrogen, to yield benzene, toluene, and the xylenes. Raw product is again depentanized to remove any pentanes and lighter formed during this operation, then sent to the Udex unit for separation. Total aromatics production from this operation is approximately 95 per cent of charge.

The Udex unit operates on a separate system, charging some 1600 bbl per day from floating roof storage where it is held out of contact with air. This stock is charged at about the middle of the extraction column in which it rises to meet a downflowing stream that contains diethylene glycol. This solvent dissolves the aromatics selectively and forms a separate layer from the portion which includes the paraffins and other non-aromatic constituents. The aromatics-carrying solvent stream enters a stripper column in which solvent and aromatic mixture product are separated and solvent returns to the absorption step in its cycle. The aromatic mixture goes to three columns from each of which a single aromatic-benzene, toluene, and lastly the xylenes, is segregated in nitration grade material, that is, containing only a small fraction of one per cent of impurities or material other than the substance wanted. In the xylene fraction the three isomeric xylenes, ortho-, meta-, and para-xylene, show typical proportions as follows:

Toluene ..... Less than 1 vol per cent
Para-xylene .... Less than 18 vol per cent
Meta-xylene .... Less than 39 vol per cent
Ortho-xylene .. Less than 24 vol per cent
Ethylbenzene .. Less than 19 vol per cent
Higher aromatics ..... NONE

Control of the entire Platformer-Udex system centers in a Panellit graphic panel, that includes 64 strip chart recorders to indicate and record each phase of the whole operation. One departure in the system is the use of air-cooled units instead of water exchanger-coolers, under conditions where the water side of the exchangers have shown serious fouling and thus difficulties.

The properties of the different products from this operation are shown in detail in the accompanying table at lower left.

Although the situation of each refiner varies in greater or less degree from that of any other, the diversification of operation and of product offered by new processes such as those described briefly here make for greater plant flexibility to meet the phenomenal growth of the petrochemical and the expanding refining industries. This short short story shows how one refiner is preparing his facilities for specialization to augment his production of "standard" refined products, to make of his refinery a chemical plant, as all of them are becoming. * * *

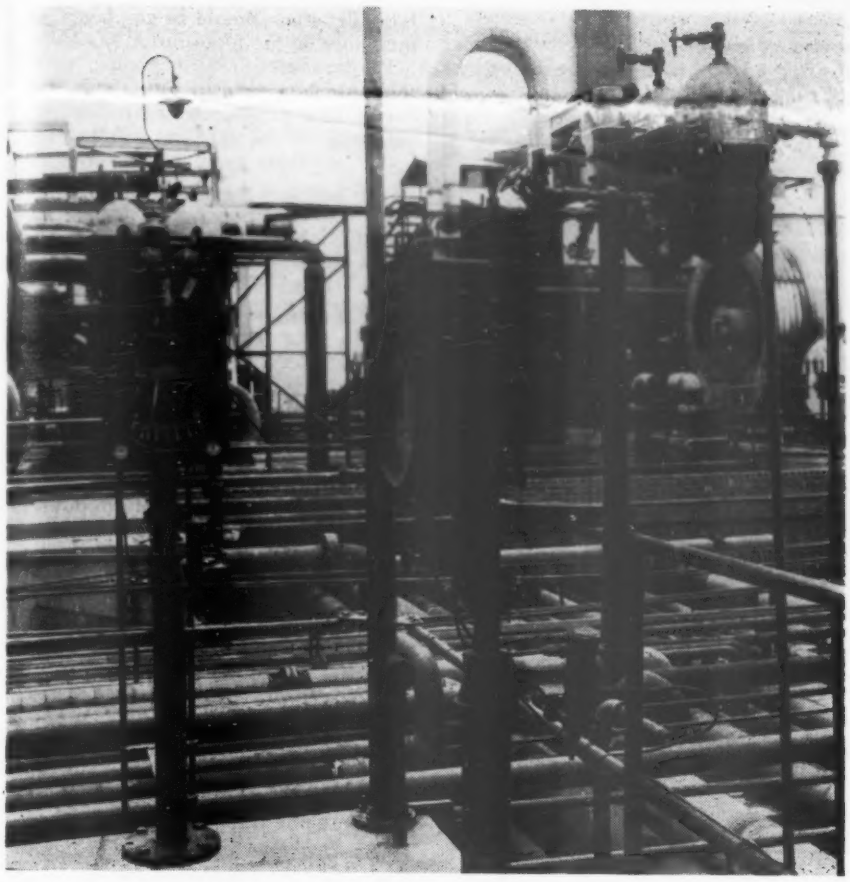


FIG. 1. Orifice meters in action at a large petroleum refinery.

TRENDS IN

Refinery Instrumentation

PART 8 — Installation and maintenance of orifice meters

S. D. ROSS* and J. PROCOPI*

PROBABLY no other instrument is as widely employed throughout the petroleum industry as the orifice meter. The accuracy of the records supplied by these meters, and the extent to which the capital investment in the instruments will be protected are determined by how much time and effort is expended in their maintenance. This maintenance activity should be delegated to individuals who have been properly trained in this class of instrument work. They alone should be permitted to make meter adjustments, as well as supervise installation.

The importance of correct meter installations can not be overemphasized. Too often the basic principles of complete and satisfactory installation are ignored, with resulting errors in meter readings. Care should be exercised in the installation of an orifice plate or other primary device, as well as in the fitting of connecting piping.

EXCLUSIVE

*Brown Instruments Division, Minneapolis-Honeywell Regulator Company.

Present day practice (where mercury meters are employed) involves the use of many varied piping arrangements in order to obtain satisfactory metering of corrosive, volatile or viscous fluids by use of sealing liquids, purging and other special systems.[1] All of these devices are located in the interconnecting piping and when properly installed and maintained, provide the means of solving a difficult metering problem. When they are improperly installed or maintained, however, the metering system is useless.

Installation of Orifice Plate and Piping

In installing an orifice plate, for example, there are several precautions that must be observed. First, the orifice must be installed in the proper direction with the sharp and square edge facing upstream. The plate must also be centered in the flange so that the orifice opening is concentric with the pipe. Gaskets used on each side of the plate should be cut and carefully positioned in order that they will not obstruct the opening.

Faulty installation of the taps is another source of metering errors. Most usually encountered are: (1) pipe tap nipple projecting beyond the inside wall of pipe into the stream, and (2) burrs left on the inside of pipe as a result of drilling and tapping operations. When the former situation is encountered, it is advisable to obtain sufficient thread surface either by welding a half coupling to the outside of the pipe or by building up the metal with a torch. Burrs can be removed by smoothing with fine emery cloth.

Straight Pipe Requirements. Related to the matter of proper installation of the orifice plate is the question of the length of straight pipe required on both sides of the primary element. Usually, a range of five pipe diameters is sufficient on the downstream side of an orifice plate. On the upstream side, the required length is a function of the orifice ratio and the types of fittings preceding it. The proper length for each piping layout can be determined by referring to available publications of the American Society of Mechanical Engineers Fluid Meter Committee.[2]

Connecting the Meter. The simplest and most satisfactory means of connecting the meter body with these flow line taps is by the use of ½-in. OD copper tubing and compression fittings, thereby eliminating troublesome joints. Where flow conditions preclude the use of copper, stainless steel tubing, either with compression fittings or pipe threads, can be employed.

In order to eliminate the possibility of trapping air in the connecting piping when a fluid is being measured, this tubing should slope downward toward the meter body at least one inch per foot. The grading should be maintained

[1] A discussion of these piping arrangements is contained in "Principles and Operation of Differential Fluid Meters" published by Minneapolis-Honeywell Regulator Company.

[2] An engineering aid to these calculations is "Flow Meter Engineering Handbook" published by Minneapolis-Honeywell Regulator Company.

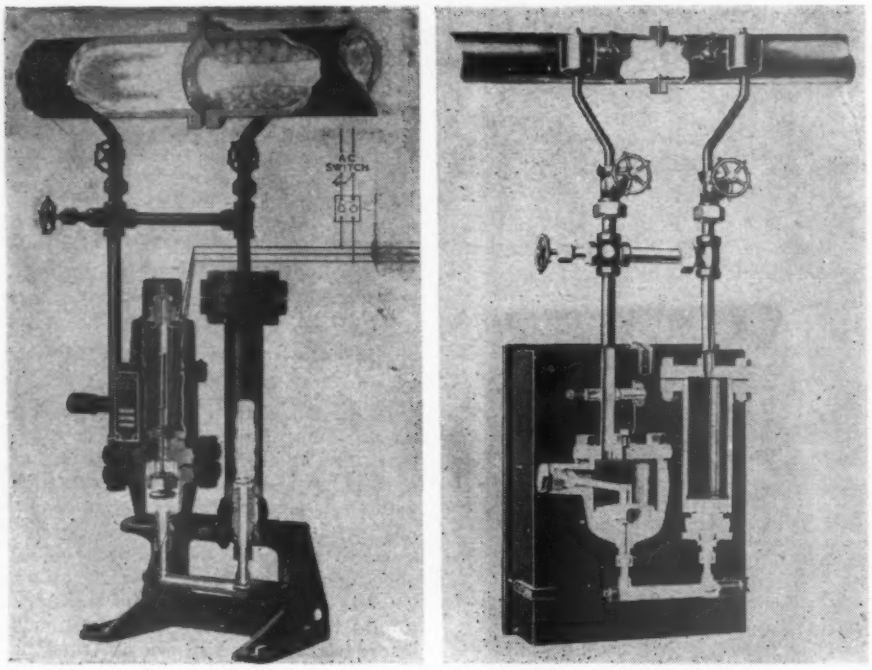


FIG. 2. Typical differential pressure "square-root" type electric flow meter (left) and mechanical type (right). Installation and maintenance practices recommended in this article apply to "square-root" type meter, both mechanical and electrical, as well as to the "linear" Ledoux bell meter.

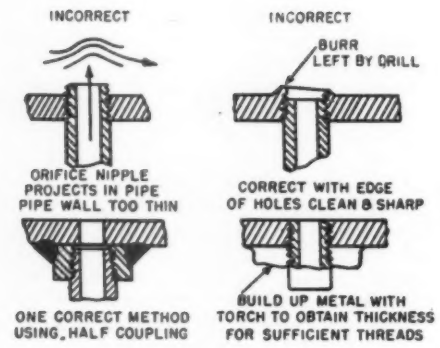

INCORRECT
ORIFICE NIPPLE PROJECTS IN PIPE PIPE WALL TOO THIN
ONE CORRECT METHOD USING HALF COUPLING
INCORRECT
BURR LEFT BY DRILL
CORRECT WITH EDGE OF HOLES CLEAN & SHARP
BUILD UP METAL WITH TORCH TO OBTAIN THICKNESS FOR SUFFICIENT THREADS

FIG. 3. Correct and incorrect methods of installing taps.

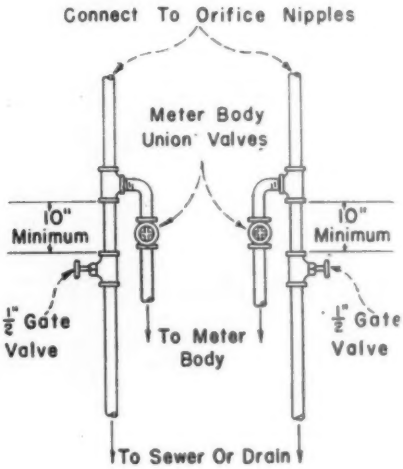


FIG. 4. Blow-down piping installation.

by firmly supporting the tubing, thus eliminating any possibility of sagging.

Union valves are especially useful for connecting the tubing to the meter, since they can be disconnected and screwed in the piping or the tube connectors. They also facilitate the blowing-down of orifice piping. Where blowdown must be effected at frequent intervals, permanent blow-off valves should be provided, as illustrated.

Maintenance of Orifice Plate and Piping

Operating conditions in the flow lines sometimes affect the shape of the orifice plate, causing meter errors. Fortunately, these conditions are not encountered frequently but when they do, are serious. The most common causes of orifice plate trouble are shown in Fig. 5. When the fluid being measured contains abrasives, rounding of the upstream edge oftentimes occurs, resulting in low meter readings. Wire drawing and warping of the plate can cause either low or high readings.

All of these conditions, with the exception of solids accumulation, necessitate the installation of a new orifice plate. The solids can usually be removed by means of a solvent. If the use of a solvent is impractical, or if the solids can not be dislodged by this means, a large flat stone should be employed, and then only on the plate face.

Piping System. Maintenance of the piping system (which includes all of the valves, fittings, condenser pots, and seal pots between the flow line and the meter body) includes periodic checking for:

(1) *Leaks at pipe connections, valves, and meter body joints.* The smallest leak will result in incorrect differential pressures on the meter body, with consequent errors in flow reading.

(2) *Levelness of condensers and seal pots.* Incorrect leveling produces errors, due to change in static head. Although this error can not be detected by normal zeroing (equalizing) of the meter body, it will exist and therefore precautions should be taken to eliminate it.

(3) *Clogging of connecting lines.* Connecting lines must be blown down to keep them free from clogging. The installation of auxiliary blowdown valves facilitates this work, thereby eliminating one source of sluggish meter operation.

(4) *Venting of piping.* On liquid installations, the connecting piping should be arranged so that it will be self-venting. The lines should be checked periodically to determine whether they are air or gas bound. High spots in the lines should be provided with suitable vents and should be regularly opened in order to release any trapped gases.

(5) *Drainage of piping.* On gas installations, the connecting piping should be self-draining, normally back to the flow line. The lines should be checked periodically for trapped liquids.

(6) *Contamination of sealing liquids.* On installations employing seal pots, periodic checks should be made to determine that the flowing fluid is not contaminating the sealing liquid. This test involves comparing a sample of the sealing fluid from the seal pot with a sample of unused sealing liquid. The seal pot test sample can be drawn at one of the various try-cock levels with both reference and test portions being collected in test tubes or clear glass bottles. Where contamination is present in the seal pot fluid, as determined by its physical appearance, both the seal pots and meter body should be cleaned and refilled with clean liquid.

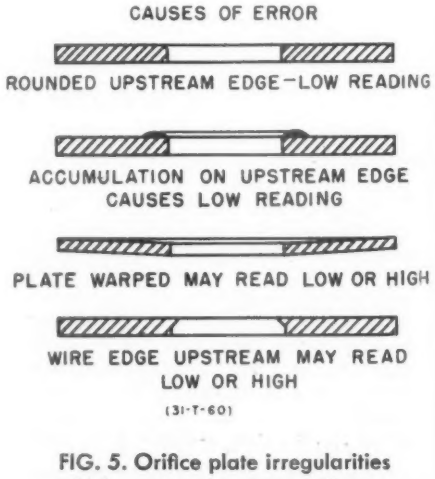

CAUSES OF ERROR
ROUNDED UPSTREAM EDGE—LOW READING
ACCUMULATION ON UPSTREAM EDGE CAUSES LOW READING
PLATE WARPED MAY READ LOW OR HIGH
WIRE EDGE UPSTREAM MAY READ LOW OR HIGH
(31-T-60)

FIG. 5. Orifice plate irregularities which cause erroneous readings.

FIG. 6. Differential Converter, a mercuryless differential pressure transmitter.

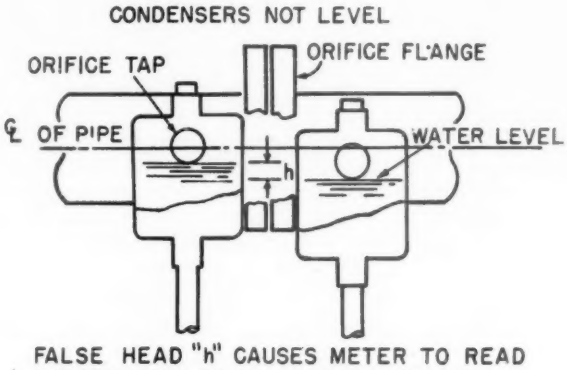

CONDENSERS NOT LEVEL
ORIFICE TAP
ORIFICE FLANGE
℄ OF PIPE
WATER LEVEL
h
FALSE HEAD "h" CAUSES METER TO READ EITHER HIGH OR LOW DEPENDING ON DIRECTION OF FLOW.

FIG. 7. Installation of condenser pots in steam metering with the mercury type meter. These pots are not required with the differential converter.

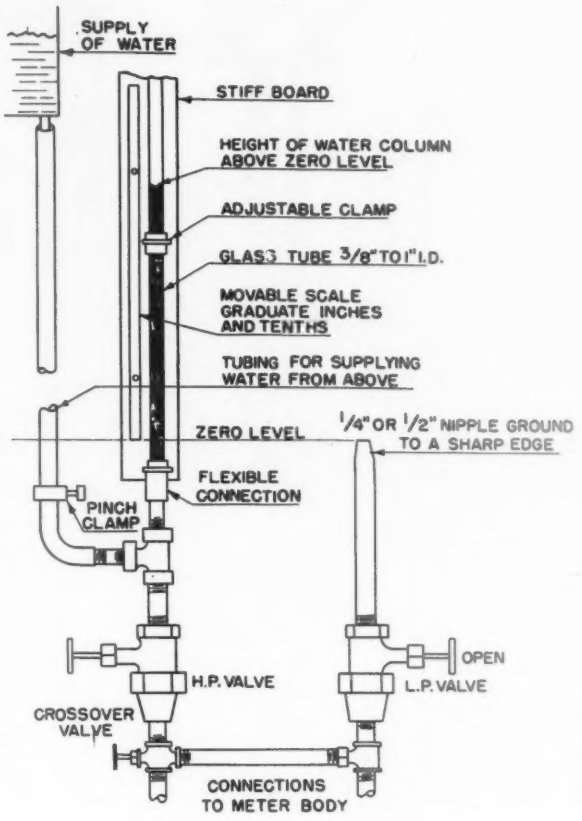


FIG. 8. Standard column for running "wet" calibration check on meter with 20-in. differential.

After the above maintenance has been performed, the instrument should not be checked for zero until sufficient time has elapsed to permit stabilization of the equipment at normal operating conditions. This "zeroing" procedure is described in the manufacturer's literature.[3]

Installation of the Mercury Meter Body

In steam measurement, when the mercury type meter is employed, condensate chambers must be provided in order to eliminate variations in the static liquid head which can result from the accumulation of condensate on the mercury. Where a mercuryless type meter, such as the *Differential Converter* is employed, however, this condensate produces no change in the static head, hence the need for condenser pots is eliminated.

Where the mercury meter is employed in steam measurement, however, condensate pots must be level (as illustrated), otherwise faulty readings will occur. It is also advisable to install the meter body below the orifice level, so that there will always be a positive head of water on both sides. When the meter must be installed above the orifice, piping arrangements should provide adequate and simple means for venting entrapped air from the line. This is accomplished by placing nipples and vent cocks at the highest point in the line. These recommendations also apply for measurement of liquids.

Gas and Corrosive Fluids. In gas measurement, if the gas or air is dry, the meter body can be located above or below the orifice plate. In either case, the orifice connections should be on top of the pipe. If the meter body must be located below the flow line, the orifice piping should extend upward six or eight feet, and then bend downward to the meter through a large radius, as illustrated. If the gas or air is moist, the meter body should be located above the flow line in order that condensate may drain into the flowing fluid.

The metering of corrosive gases and liquids requires the use of inert gas purges for the former, and sealing liquids or purges for the latter, in order to prevent corrosion of the meter body. A discussion of these systems is contained in a publication[1] previously mentioned.

Installation of the Differential Converter

When installing a Differential Converter, a location that is reasonably free of vibration should be selected. Ambient temperature should not rise above 225 F or fall below freezing.

Place the unit as close as possible to the orifice. Best performance is obtained when the Differential Converter is within 3 to 4 ft of the orifice. This eliminates long lengths of piping which may cause the meter to respond sluggishly. For steam or water measurements, the meter body should not be situated more than 100 ft from the orifice. For gas measurement, this distance should not exceed 50 ft.

Steam Measurement Installation

When measuring steam locate the unit below the orifice plate, with a slight slope of the connecting piping downward to the unit. The piping will then be self-venting. When the piping is filled, a certain amount of entrained gas or air is always present and when the system is placed under pressure, it will be forced into the flow line. Satisfactory results can be obtained with the unit located above the level of the orifice

[3] Instruction Manual published by Honeywell, contains installation and service instructions.

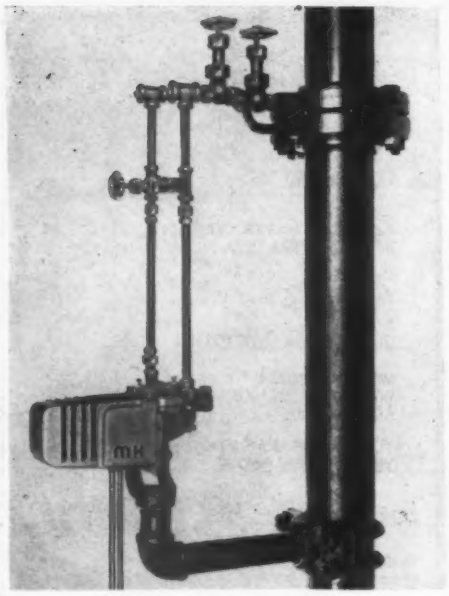


FIG. 9. Pipe saddle and yoke method of mounting Differential Converter for liquid or steam flow in vertical pipe line.

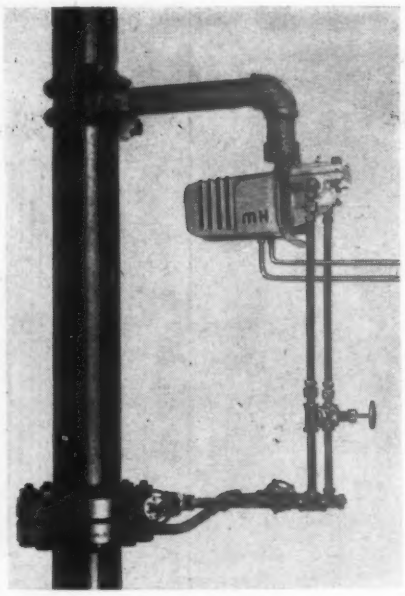


FIG. 10. Pipe saddle and yoke method of mounting Differential Converter for gas flow in a vertical pipe line.

plate, but the piping is more complicated.

On the steam installations, it is recommended that bent nipples be used at the orifice connections to help to maintain a constant head of water on the meter diaphragm.

Since the maximum displacement of the meter is approximately ¼ cu in., it is possible to produce, in a ½-in. pipe, a differential head error of ¾ of an inch; hence the need for bent pipe nipples. These nipples act as small condensers and minimize any errors owing to meter displacement.

Liquid Measurement Installation

The same recommendations apply for liquids as for steam. If the unit must be located above the flow line, suitable traps must be installed for segregation of any gas evolved. It will be necessary to vent these traps periodically to get satisfactory service from the meter.

Gas Measurement Installation

If the gas or air is dry, place the unit above or below the orifice plate. The orifice connections should be made on the top of the pipe. If the unit is located below the flow line, the orifice piping should be made on the top of the pipe and the piping should extend upward 6 or 8 feet, and then make a large radius bend down to the meter.

If the gas or air is moist, it is always best to locate the unit above the flow line in order that any condensation which may take place in the piping will drain back into the flow line. If the location must be below the level of the orifice, the installation of traps will effectively reduce the amount of liquid that will enter the meter body.

TABLE 1. Recommended flow meter maintenance schedule.

Item	Daily	Weekly	Monthly	Yearly
Ink pens	x	..	..	..
Check zero	..	x	..	..
Lubricate pressure tight bearing (mechanical)	..	x	..	..
Blow-down connecting piping	..	..	x	..
Check for leaks	..	..	x	..
Check sealing fluid	..	..	x	..
Check levels—seal pots, condensors, meter body	..	..	x	..
Check pen pressure on chart	..	..	x	..
Complete overhaul	..	..	..	x

Maintenance of the Mercury Meter Body

Periodic cleaning, checking and calibration of flow meters are requisites for consistent accuracy and long meter life. It is a well known fact that troublesome errors can result, for example, from scale or scum accumulation on the inside of a range tube, especially in the higher ranges.

The details of a periodic maintenance and calibration program for mercury meters (shown in Table 1) are covered in the manufacturer's literature.[3] Maintenance procedures[3] for the mercuryless type meter, the *Differential Converter*, are also available from the manufacturer.

☆ ☆ ☆

Research Project Initiated

Catalyst deactivation is the subject of a fundamental research project initiated by Armour Research Foundation of Illinois Institute of Technology. Program was announced by K. W. Miller, assistant director, research.

"Although great strides have been made in clarifying the mechanism of catalyst action," Miller said, "the fundamental changes in catalyst structure that cause or accompany deactivation of contact catalysts are not so well understood.

"We hope that application of X-ray and electron diffraction and other techniques will reveal clues."

Zero Check. The meter body should be equalized and checked on zero at least weekly. Any tendency of the zero to drift continuously up or downscale or to shift suddenly indicates some malfunction. This trouble may be caused by: Leakage; meter body not level; connecting piping faults; dirt in the meter body; and occasionally, contamination of the sealing fluid, where one is being used. If the trouble persists after the previously described checks on the connecting piping have been made, the meter body should be disconnected and cleaned.

Cleaning the Meter Body. Experience will usually determine the extent of cleaning required. When either silt, loose scale, or mud is found in the meter, thorough flushing with high pressure water will usually suffice. The meter body should be disconnected, the mercury drained and, if an electrical type meter, the power turned off and the leads disconnected. A high pressure water line should be connected to the low pressure side of the meter. Water should be permitted to flow through the meter until the effluent is clear.

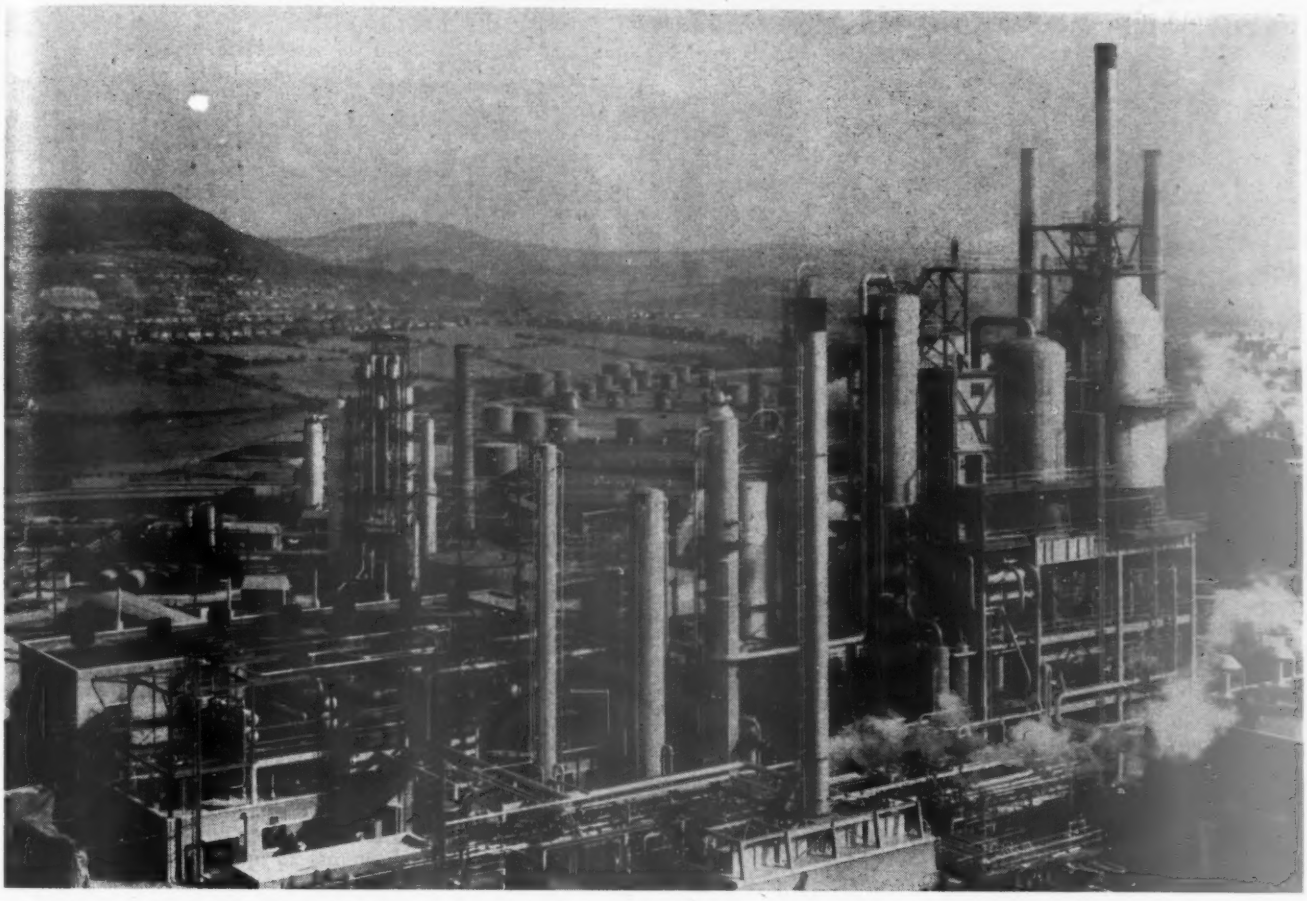
When the mercury is badly amalgamated, it should be replaced. If facilities are available, the mercury can be distilled or purified by washing with acid. Usually, however, satisfactory results can be obtained by washing the mercury with water and filtering it through a fine chamois cloth.

Calibration of the Mercury Meter. Calibration should be checked periodically. The meter body should be clean and a suitable standard check column must be available. The type of standard column used will depend upon the facilities available and upon the differential range of the meters being checked.

Fig. 8 illustrates an arrangement for use on meters with 20 in. of water differential and which are to be "wet" calibrated, i.e., with water in the meter above the mercury. In making the column, it is advisable to use ½-in. ID glass tubing in order to reduce meniscus effect and errors in reading.

The water supply tank is placed above the highest water column marking, with the filling line coming in below the zero level on the gage. Where possible, distilled water should be used. Care must be exercised when filling the system and the meter body so that any trapped air will be expelled. The actual method for performing a "wet" calibration is described in the manufacturer's literature.[3] This reference should also be checked to determine the preliminary steps that must be taken prior to calibrating the electric type meter body, in order to ensure that the transmitting and receiving armatures are in the correct position and that the instrument is in static balance. ★ ★ ★

Part 9 of this series of instrumentation will be published in an early issue.



General view of Anglo-Iranian's Llandarcy refinery, South Wales. It is now handling more than 28,000,000 bbl. per year. New catalytic cracking unit is in foreground.

Refinery Expansion in Eastern Hemisphere

Shutdown of oil activities in Iran following dispute with AIOC brought about increased throughputs outside country

V. S. SWAMINATHAN

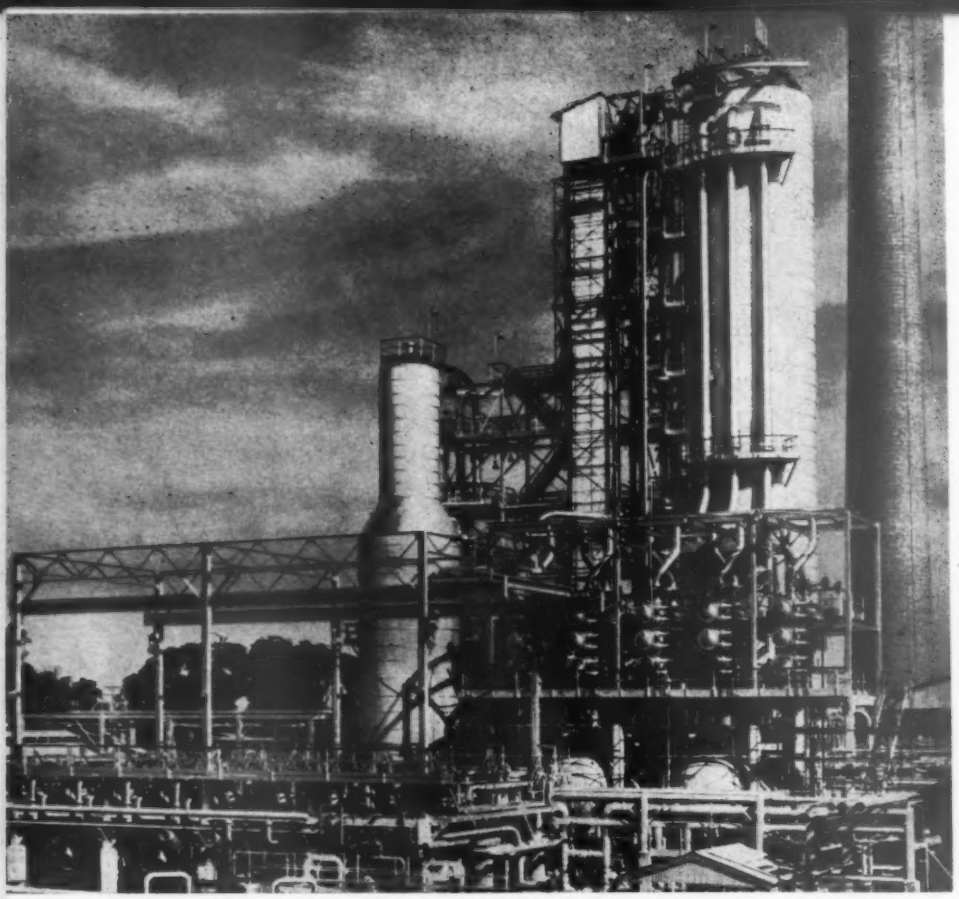
In June 1951 a blow was struck which shook the world's oil industry. Then differences between the Government of Persia and the Anglo-Iranian Oil Company, Ltd., resulted in the shut-down of that country's production and refining. Iran was the oldest and largest producer in the Middle East and the third largest in the non-Communist world. During the first half of 1951 its crude output, of approximately 660,000 bbl per day, represented nearly a third of all Middle East output. Iran was then exporting 150,000 bbl per day of crude to the world's markets, but the bulk of its production fed the great Abadan refinery, whose daily shipments of finished products came to 460,000 bbl. Largest of the world's refineries, Abadan alone accounted for more than a fifth of all petroleum products refined in the free countries of the Eastern Hemisphere.

It is a glowing tribute both to the resourcefulness and flexibility of the world oil industry that the acute supply problems occasioned by the cessation of shipments of crude and products from Persia were so successfully faced. Industry committees formed under government *aegis* worked on these pressing problems in America, Britain, and elsewhere, and oil companies on both sides of the Atlantic rose to the occasion.

Since the end of the Second World War and more particularly following the Persian deadlock, there have been

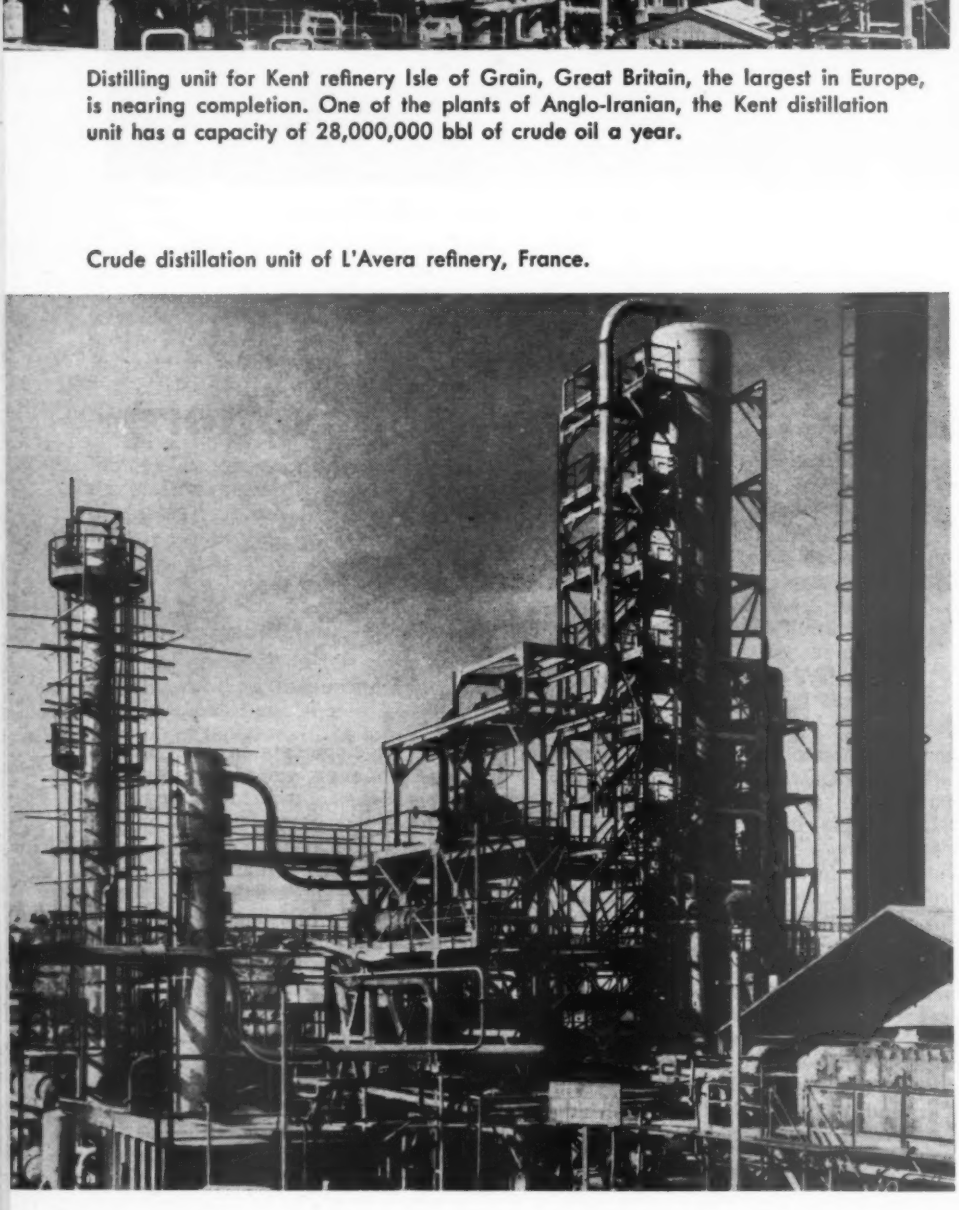
EXCLUSIVE

arresting developments in the Anglo-Iranian Company's widespread interests and operations outside that country. Since, for a start, products most in demand, apart from aviation gasoline, were fuel oil and gas oil, virtually every other of the group's refinery was able to force distillation units and modify, or convert, cracking plants and thermal reformers to serve as distillation units to squeeze extra capacity. Thus intensive and successful efforts were made to increase throughputs at the various installations outside Iran, and urgent consideration was accorded to the erection of further new refineries. Anglo-Iranian has built, or is building 16 refineries outside Persia. By 1955 its overall refining capacity of 224,000,000 bbl a year



Distilling unit for Kent refinery Isle of Grain, Great Britain, the largest in Europe, is nearing completion. One of the plants of Anglo-Iranian, the Kent distillation unit has a capacity of 28,000,000 bbl of crude oil a year.

Crude distillation unit of L'Avera refinery, France.



will have nearly reached the 228,000,000 bbl per annum peak just before the close down of Abadan.

Refineries associated with the Anglo-Iranian group are: National Oil Refineries, Llandarcy, South Wales; Scottish Oils, Ltd., at Grangemouth and Pumpherston adjoining that site, and Kent Oil Refinery (all in Great Britain); L'Avera and Dunkirk in France; Antwerp in Belgium; Hamburg and the Schwindler group in Germany, Marghera in Italy; Haifa in Palestine; Alwand in Iraq; Kuwait in that Sheikhdom, and Laverton in Australia. The company is also erecting two new large refineries at Aden in Arabia, and Kwinana in Western Australia.

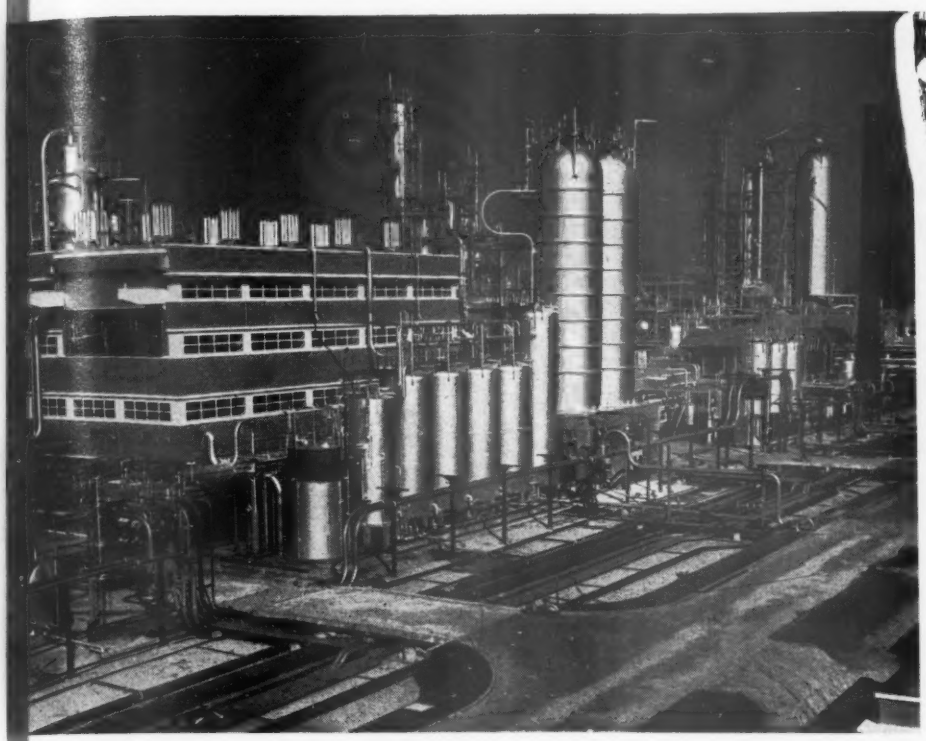
In U. K. complete new refineries are nearing completion in and around the sites of the old at Llandarcy and Grangemouth. In both cases new power stations and boiler batteries are being provided, and entirely new and separate cooling water circulating systems and docks with trans-shipment facilities. Before the second World War Llandarcy treated 2,800,000 bbl of crude oil a year. Now its annual throughput is nearly 28,000,000 bbl. This 10-fold expansion was accomplished by running the original main crude oil distillation unit rated at 7700 bbl per day at 12,950 bbl daily, by converting two cracking units to crude distillation units to process 15,400 bbl per day between them; by continuing to operate an old shell distillation unit rated at 550 tons per day, and by pushing the new unit rated at 42,000 to 49,000 bbl per day. It was found that the treatment plants had extra capacity, and only one new acid washery for motor spirit has so far been constructed.

The Grangemouth refinery, which had a pre-war annual throughput of 2,555,000 bbl, is now operating at 15,750,000 bbl a year. This increase was brought about by continuing to operate the original shell still distillation units at 7000 bbl per day, by converting two cracking plants to distill 14,000 bbl per day, between them, by pushing the new distillation unit rated at 26,250 to 30,450 bbl per day. The power station and boiler battery came into service last April.

At Pumpherston refinery, operating on Scottish shale-oil and crude petroleum produced in the United Kingdom, the throughput was 1,043,000 bbl. Detergents produced at this plant are finding an increasing market, and new products are being developed.

The British Petroleum Chemicals (BPC), Ltd., plant at Grangemouth, in which the Anglo-Iranian are partners with The Distillers Company, Ltd., began production of commercial alcohol in May 1951. The neighboring plant of Forth Chemicals, Ltd., jointly owned by the BPC and Monsanto Chemicals, Ltd., now under construction, is expected to commence manufacture of styrene before the end of 1952.

Good progress is being made with the Kent refinery, which began operations at half its eventual 28,000,000 tons per annum capacity during the fall of 1952. Catalytic cracking units for the production of high-grade motor spirit are be-



Dunkirk refinery, France, as seen in 1952.

ing installed at the Kent, Grangemouth, and Llandarcy refineries.

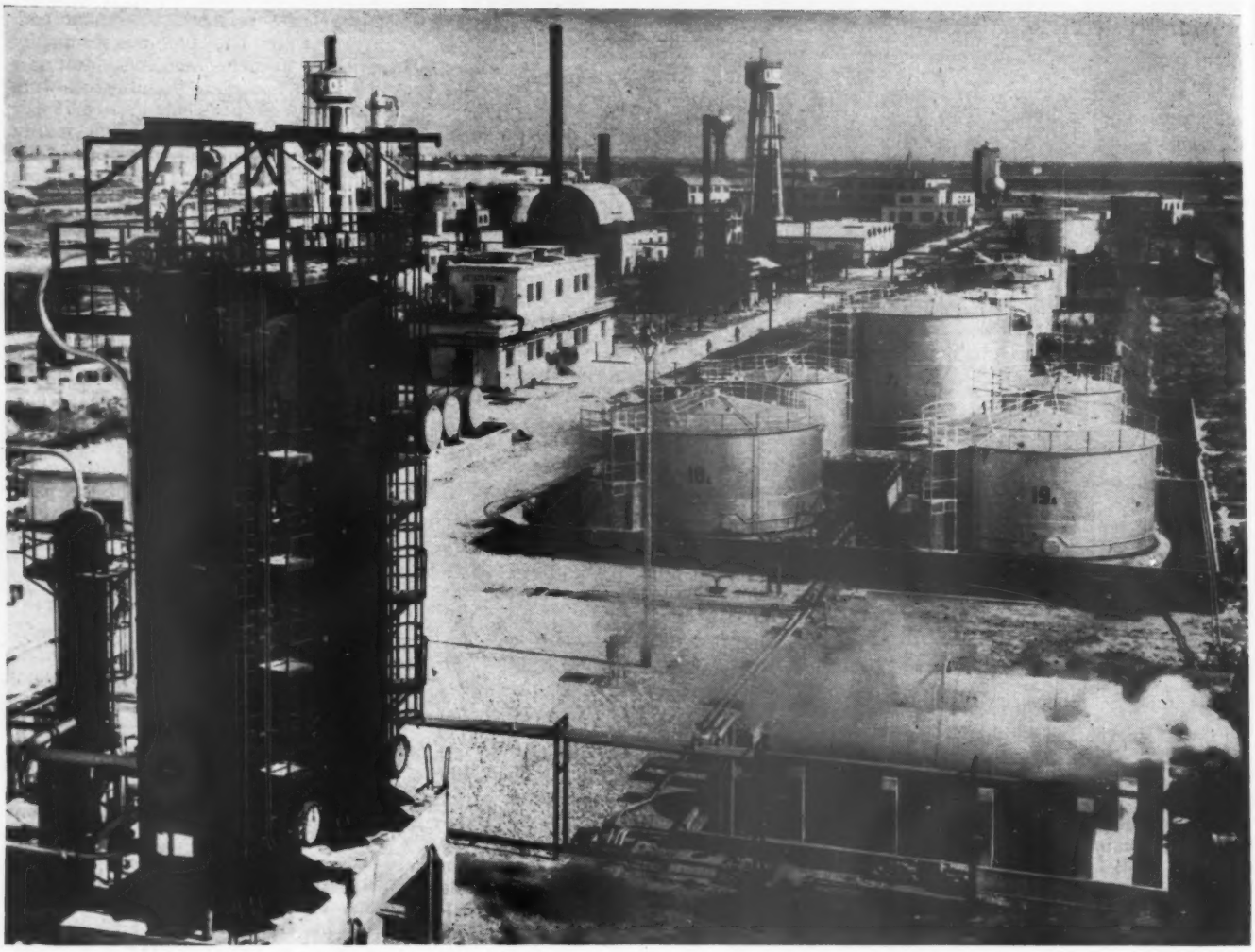
L'Avera refinery, owned by SGHP, French associate of the AIOC, and situated on Lake Berre, 30 miles from Marseilles, was built in 1932, the main contractor being M. W. Kellog Company, and designed for a throughput of 2,800,000 bbl a year. Without any major additions this plant is now treating 12,600,000 bbl of crude oil per annum. The original distillation unit, rated at 11,200 bbl per day by its designers, is processing 15,400 bbl per day. The cracking plant is distilling 12,600 bbl per day of crude, and the vacuum distillation unit 11,200 bbl per day, and it will do 15,400 bbl per day pending installation of an extra flash column. The original treatment plants have been sub-divided so that there are six banks of treaters in place of two, and one extra chloride sweetener has been erected out of salvaged vessels from the destroyed and written-off refinery at Courchelettes. The steam, power, and water services has had very little extension, and only a few extra storage tanks have been provided as new.

Dunkirk, also operated by SGHP, is a new plant, first commissioned in October 1951. The smaller of the two crude distillation units was salvaged from the Courchelettes refinery. The main contractors were The Lummus Company and their French associates. Materials for construction came from the following areas: USA 20 per cent, France 75 per cent, and U. K. 5 per cent. The smaller of the two distillation units previously rated at 900 tons per day is now being operated at 14,800 bbl per day, and the larger one designed for 23,800 bbl per day is now distilling 38,500 bbl daily. These two units have a capacity of 40,000 bbl per day, or 2,000,000 tons a year. The catalytic reformer will account for 6000 bbl per day, or 1,750,000 bbl a year. The lube oil plant is producing 420,000 bbl of high grade lubricating oils yearly. Electricity is generated in a refinery power station employing back-pressure turbines taking steam at 900 psig, and exhausting into the refinery mains at 175 psig. The company has also built a new jetty in Dunkirk Harbour, capable of accommodating two of the most modern super-tankers.

The Antwerp refinery, operated by SIBP, an association of Petrofina, Ltd., and Anglo-Iranian formed in 1948, represents a brand new project. The main contractors were The M. W. Kellogg Company, responsible for all process plant and the refinery generally, but the boiler plant, power station and electricity distribution system were developed in Britain. Here also pass-out turbines were used, but with very limited condensing capacity.

The refining plant consists of crude distillation, cracking, and reforming units, as well as the usual treatment plant, but there is no lube oil line. Commissioned at the beginning of October, 1951, the crude distillation unit is operating at its full design capacity of 28,000 bbl per day. The cracking plant is not commissioned as such, but as a crude unit of approximately 9800 bbl per day; and the minimum net result is that a refinery rated at 9,240,000 bbl a year

Antwerp refinery, Belgium at night with lights of Antwerp city in the background.



General view of refinery at Porto Marghera, Venice.

will process 12,609,000 bbl. The services and treatment plants are adequate to cope with this throughput, with minor adjusements.

The capacity of the Hamburg refinery, operated by B. P. Hamburg, a wholly-owned subsidiary of the Anglo-Iranian, is being enlarged; the principal addition being a crude distillation unit by Foster Wheeler. As regards materials used, 95 per cent is German and 5 per cent British. Electricity is taken from the Hamburg State-Grid, but steam is generated in a refinery boiler battery. The original combination crude distillation and cracking unit is now operating at 8400 bbl per day, and should go up further following installation of extra heat exchangers.

The Schwindler group consists of two small refineries at Neuhof in Hamburg and Peine near Hanover, both virtually wholly-owned subsidiaries of the Anglo-Iranian. The former accounts mainly for high-grade lube oils, and the latter, industrial oils and greases. Throughput of the Neuhof refinery is being stepped up from 840,000 tons a year to 1,400,000 bbl in 1953.

The Marghera refinery in Italy is operated by IROM, a joint company owned by AGIP and the Anglo-Iranian. The new plant is being added to the existing refinery, thus doubling its capacity. The original distillation unit rated 10,500 bbl per day, is doing 12,600 bbl daily; a re-distillation unit is processing crude at 1750 bbl per day for 20 days of the month, and schemes are under way to convert a coking plant to a distillation unit. The new distillation unit is rated at 10,500 bbl per day, but more than this capacity is hoped to be obtained from it. The material for the new plant is 60 per cent U. K., 30 per cent U. S. and 10 per cent Italian. This refinery produces gasoline, kerosine, gas, and fuel oils and minor amounts of industrial lube and transformer oils.

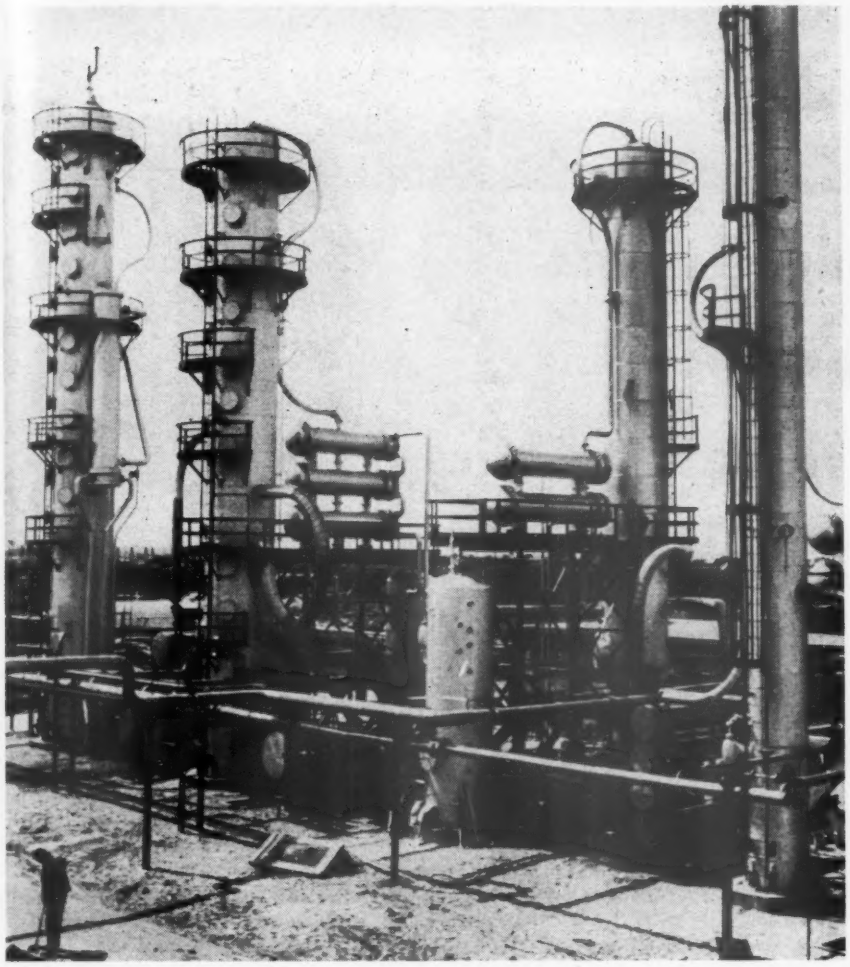
Electric power is generated in the refinery by two 1000-kw 50-cycle diesel-driven generators, two 215-kw 50 cycle diesel-driven generators, and one 110-kw 42-cycle generator. Some power is also supplied by the Italian state-owned electricity authority at 42 cycles, and converted to a 50 cycle supply. The boilers consist of two batteries, each containing two Babcock and Wilcox and two Scotch marine boilers. Water is drawn from a convenient canal.

To sum up, the European refinery expansion associated with the Anglo-Iranian group: current annual throughput at L'Avera is 14,000,000 bbl; at Dunkirk a similar figure; at Antwerp 10,500,000 bbl in 1952; at Porto Marghera 8,400,000 bbl this year; at Eurotank 4,340,000 bbl, and Schindler, Hamburg, 1,050,000 bbl.

In Iraq the Alwand refinery processed 3,010,000 bbl in 1951, an increase of 32,200 bbl on the previous year. The throughput of the Haifa refinery last year (1951) was 5,103,000 bbl, mainly of Venezuelan crude. It is still impossible to operate this plant at its full capacity of 28,000,000 bbl a year on Iraq crude oil for which it was designed. The Kuwait topping plant, the prime purpose of which is to produce bunker fuel for tankers, treated 8,099,000 bbl of crude in 1951.

Late last August J. M. Pattinson flew to Aden to discuss with the Governor and other members of that Protectorate Anglo-Iranian's plan to erect a 35,000,000 bbl a year refinery there. This refinery, entailing a capital expenditure of between $112,000,000 and $140,000,000, would take about two years to build, and would provide refined products to markets in the Red Sea, East and South Africa. The bulk of its output would be taken up in providing fuel oil for the ships' bunkering trade at Aden.

Aden is on the direct route from the company's Persian Gulf sources of supply to the African and Red Sea markets. Absorption of a considerable part of the refinery's output in the port's bunkering trade would mean economy in



Hamburg refinery, showing gas recovery plant looking west from atmosphere tower of Winkler-Koch plant.

tanker transport, as this quantity would not require re-shipment. The site of the refinery is at "Little Aden," six miles across the bay west of Aden town. Sufficient good building land is available, fresh water is to be had at an economic distance and a sea channel can be dredged and jetties built to accommodate the largest tankers now afloat. The company's existing bunkering installations at Aden could conveniently be supplied by a short pipe line around the bay.

Turning to the antipodes, following Western Australian Parliament's ratification of the agreement between the State Government and the Anglo-Iranian to build a new refinery at Kwinana, further details pertaining to this project are now to hand. The scheme is for the construction of a refinery with an annual throughput of 21,000,000 bbl at a cost of about $1,120,000. When this, the largest Australian refinery, is in full production it will meet the needs of Anglo-Iranian's Australian associates—the Commonwealth Oil Refineries Ltd., and the B. P. Company of New Zealand. It will, moreover, provide for Anglo-Iranian's Australian bunkering trade through B. P. (Australia) Ltd. Concurrently, storage and distribution facilities of the Commonwealth Oil Refineries are to be stepped up.

The Kwinana plant will comprise atmospheric and vacuum distillation units with the usual accompanying treatment plants. A catalytic cat cracker will enable high-grade petrol to be produced. The new refinery will require about 500,000 lb of steam and 5,000,000 gal of sea water for cooling purposes every hour. A power house, maintenance workshops, stores, and laboratory, equipped with test engines for product control, are to be built. Steel requirements for the project are placed at 80,000 tons, of which 20,000 tons will consist of piping of various sizes up to 60-in. diameter. Other materials needed will amount approximately to 150,000 tons.

The Western Australian Government has undertaken to make the necessary land available, supply fresh water and electricity, lay roads and railways to the site, carry out the needed dredging of the water channel through the Success and Parmelia banks to provide easy access for the biggest tankers, and build some 1000 houses for future employees.

The AIOC recently announced plans to set up five UOP platforming units, two to be erected in the UK, one in Europe, one in the Aden area and the fifth in Australia. Four of these units will have a design capacity of 6000 bbl per day, and the fifth 12,000 bbl per day. The Universal Oil Products Company has already begun engineering and design work on these five units. * * *

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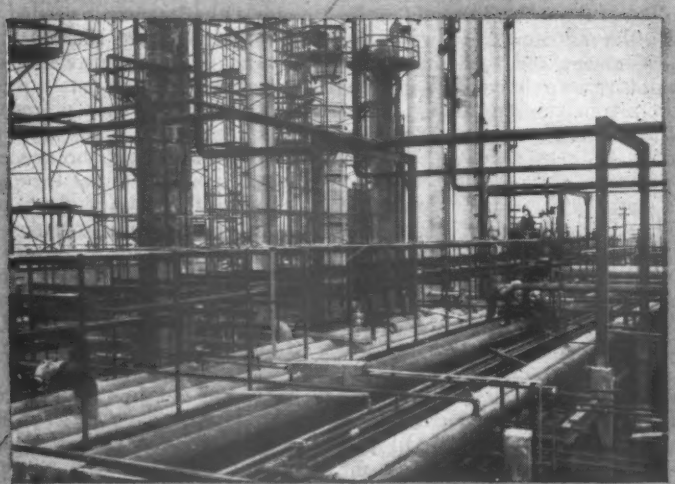

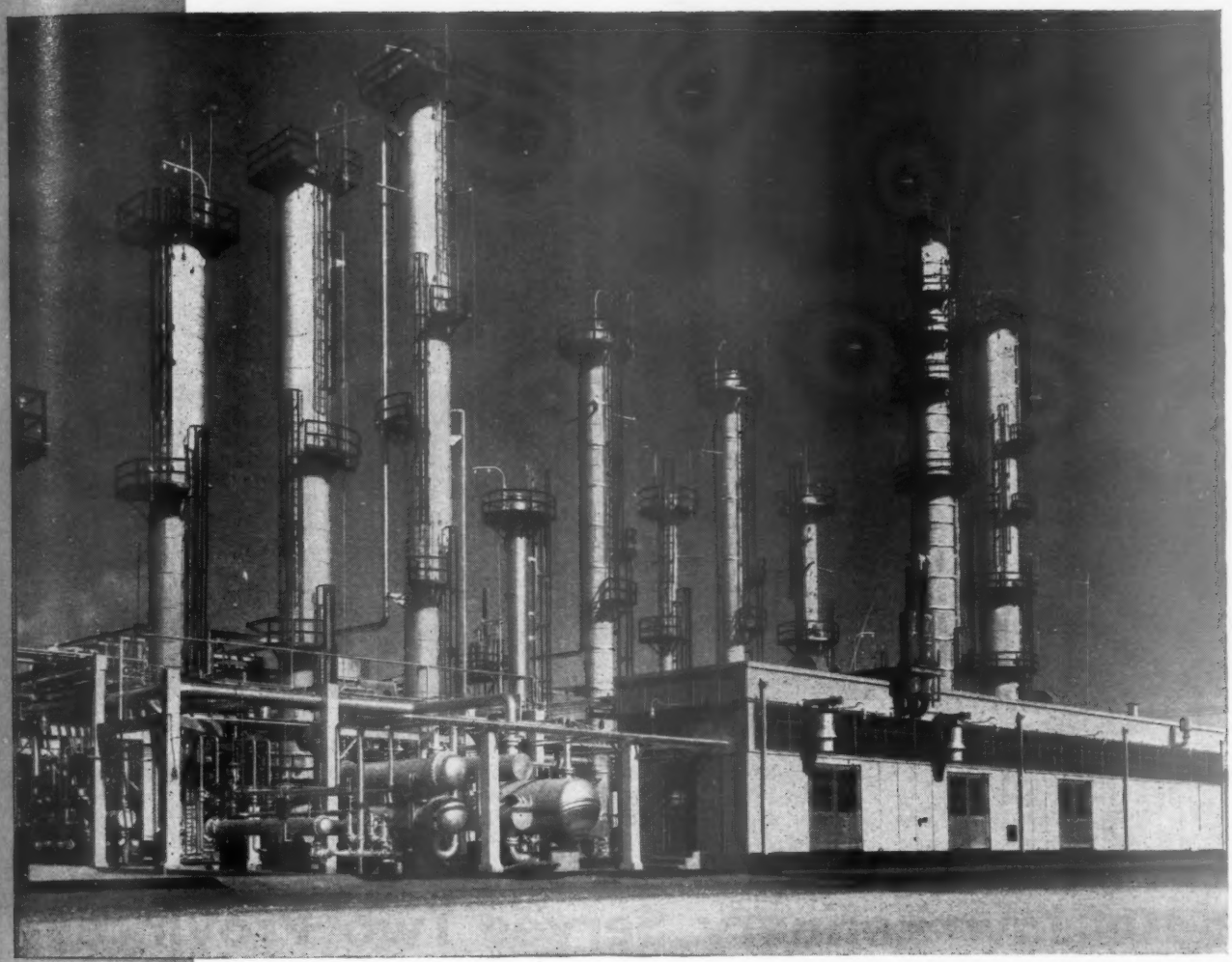

Completed by Procon in 11 months, the Platforming-Udex installation at the Big Spring, Texas, refinery of Cosden Petroleum Corporation is the **first** to produce all three aromatics — benzene, toluene, and xylene — plus a high octane motor fuel blending component.

Handling a charge of approximately 4500 barrels per day, the new facilities include a feed preparation section, a UOP Platforming Unit, a Udex unit, and a super-fractionation section. In addition, Procon also built accessory processing equipment, roadways, buildings, and utilities. All work was handled with maximum dispatch, and labor costs for the completed job were considerably below pre-construction estimates.

The successful and economical completion of this new plant is typical of Procon service on large and small construction projects for petroleum refiners throughout the world.

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Aerial view of British American Oil's newly expanded refinery at Moose Jaw, Saskatchewan.

P 721.

Moose Jaw Refinery Serves Two Provinces

British-American opens new cat cracking, polymerization, delayed coking, and gas recovery units in Saskatchewan

HARRY CHAPIN PLUMMER

To serve one of Canada's richest grain, cattle-raising, and manufacturing areas, of mushrooming population, the expanded and modernized multi-million dollar refinery of the British-American Oil Company Limited went on stream at Moose Jaw, Saskatchewan, at the end of September. The locale of the new plant which will run upwards of 15,000 bbl daily, thus constituting it the third largest of the company's refineries, is a city of 25,000. The establishment is the second of the community's industries in size.

Among the business units it will service with fuel are a 5,800,000-bushel grain elevator, which is sizable even for a country of mighty grain storage facilities at lakehead and seaports, and an expansive manufacturing aggregation. Within the Province of Saskatchewan, heart of the wheat and cattle-raising sector of the nation, British American has approximately 1000 dealer outlets and employs half a thousand men and women on a full-time basis.

EXCLUSIVE

Manitoba Province Near

Some of its most important operations center at Regina, the Provincial capital and rail and trucking hub, a city of 355,000. The adjoining Province of Manitoba also comes within the orbit of the new plant's distribution set-up.

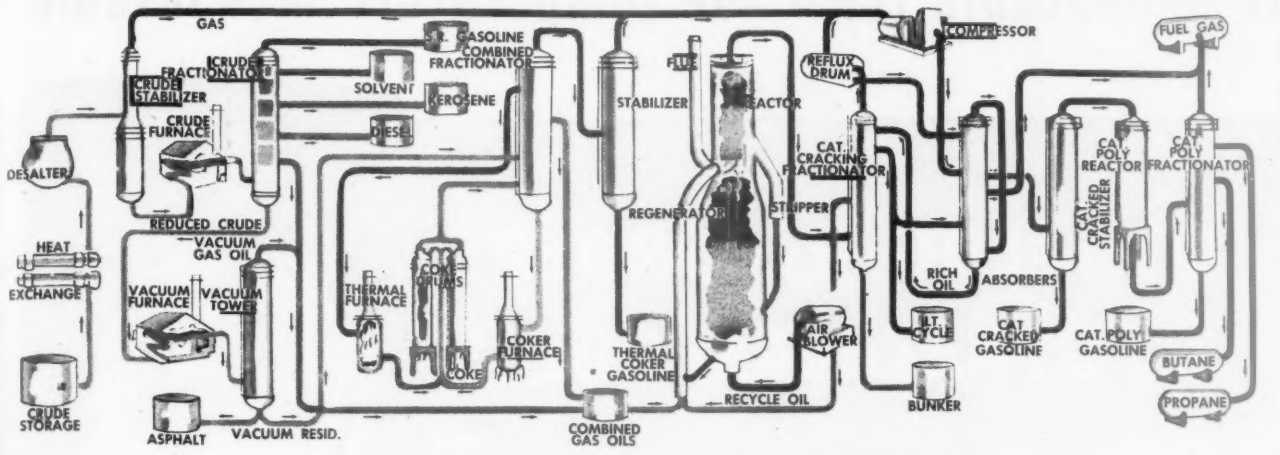
Crude oil processed at Moose Jaw is transported by pipe line from B-A's oil reserves near Edmonton to Stoney Beach, 22 miles north of the refinery, whence it is fed directly into refinery crude storage tanks through a 6-in. spur line. From the storage tanks the crude is piped through a heat exchange system. The resulting mixture of hot vapors and liquids is discharged into fractionating towers. As the rising vapors condense, products are drawn off at various levels.

Saskatchewan's First

High octane gas is produced by the plant's fluid catalytic cracking unit,

W. Earl Lundie
Manager

Lawrence P. Blaser
Assistant Manager



SIMPLIFIED FLOW CHART OF MOOSE JAW REFINERY

where the ratio of hydrogen to carbon is changed and the size and range of the hydrocarbons altered. The cat cracker is Saskatchewan's first and is the third in B-A's chain of refineries, situated at Montreal East, Edmonton, Alberta (as told and pictured in *The Petroleum Engineer*, 1950 and Oct. 1951), Clarkson, Ontario, and Calgary, Alberta.

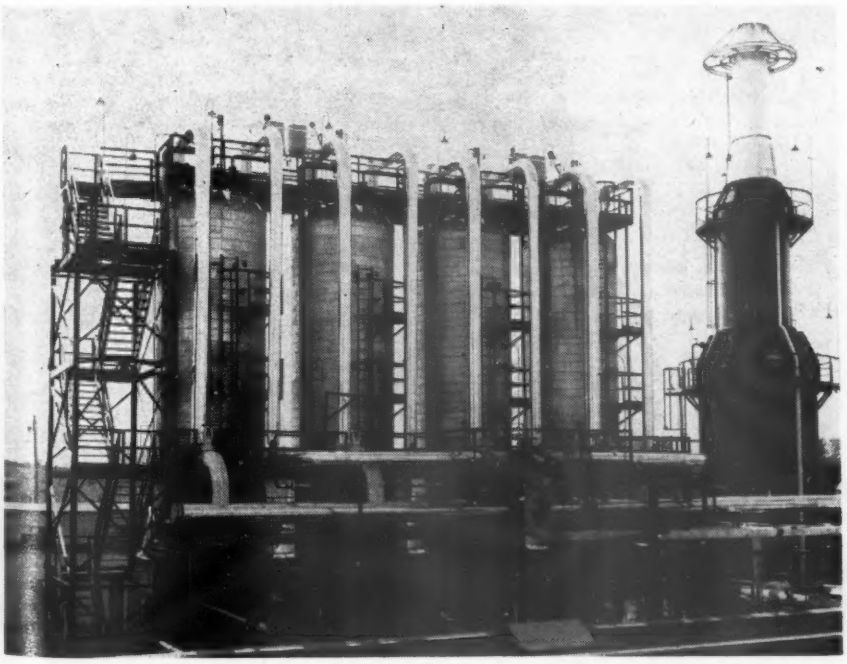
The Moose Jaw plant, which covers 122 acres, took 22 months to complete and employed a force of 550. It will employ 180 men and women. Labor and all materials possible were obtained in the Moose Jaw area. Steel piping throughout the structure totals 214,000 feet and the daily rate of electricity consumption is 30,000 kw.

Other installations include a catalytic polymerization unit and delayed coking and gas recovery units. Water-pumping and cooling equipment and product handling facilities were materially enlarged and modernized and additions made to boiler-house, electrical distribution system and sewage disposal units. Shops, stores, and a new office building complete the refinery, originally established on a much more modest scale in 1934.

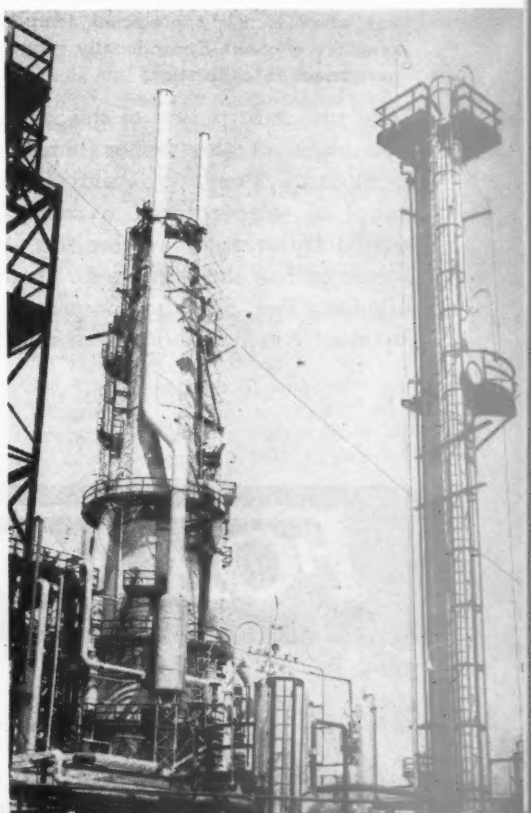
Hon. T. C. Douglas, Premier, and Hon. J. H. Brockelbank, Minister of National Resources for Saskatchewan, Hon. L. H. Lewry, Mayor of Moose Jaw, and W. Earl Lundie, manager of the Moose Jaw refinery were among the speakers at the ceremonies marking the inauguration.

Lundie, a native of Kerrobert, Saskatchewan, is a civil engineering alumnus of the Nutana Collegiate Academy and the University of Saskatchewan. His service with B-A has ranged from surveyor and gager, fireman, controlman, and operator at Moose Jaw (1934), plant engineer, Montreal East; assistant superintendent, Toronto; maintenance and T. and C. superintendent, Clarkson. He is a member of the Engineering Institute of Canada. The assistant manager, Lawrence P. Blaser, also is of Saskatchewan birth, holds the university degree of B. Sc. (1938) and rose to his present post from laborer and houseman at Calgary, assistant and chief chemist and reserve process engineer at Moose Jaw, chief engineer in charge of process engineering, and head of process engineering at headquarters office, Toronto, 1939 to 1952. * * *

The silver risers shown on the coking unit at B-A's recently expanded Moose Jaw refinery are the inlets and vapour outlets of the coke drums.



The catalytic cracking unit with debutanizer on the right.



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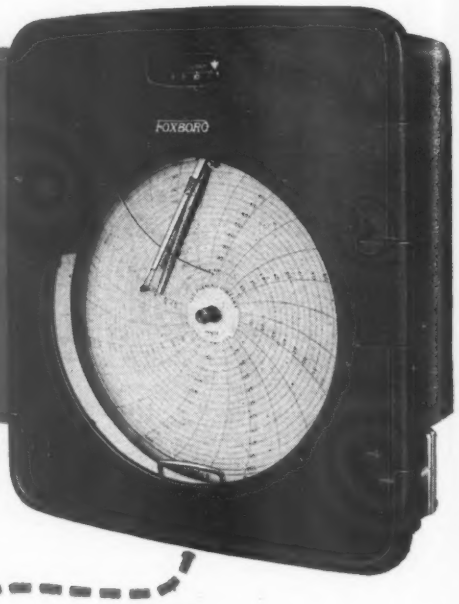

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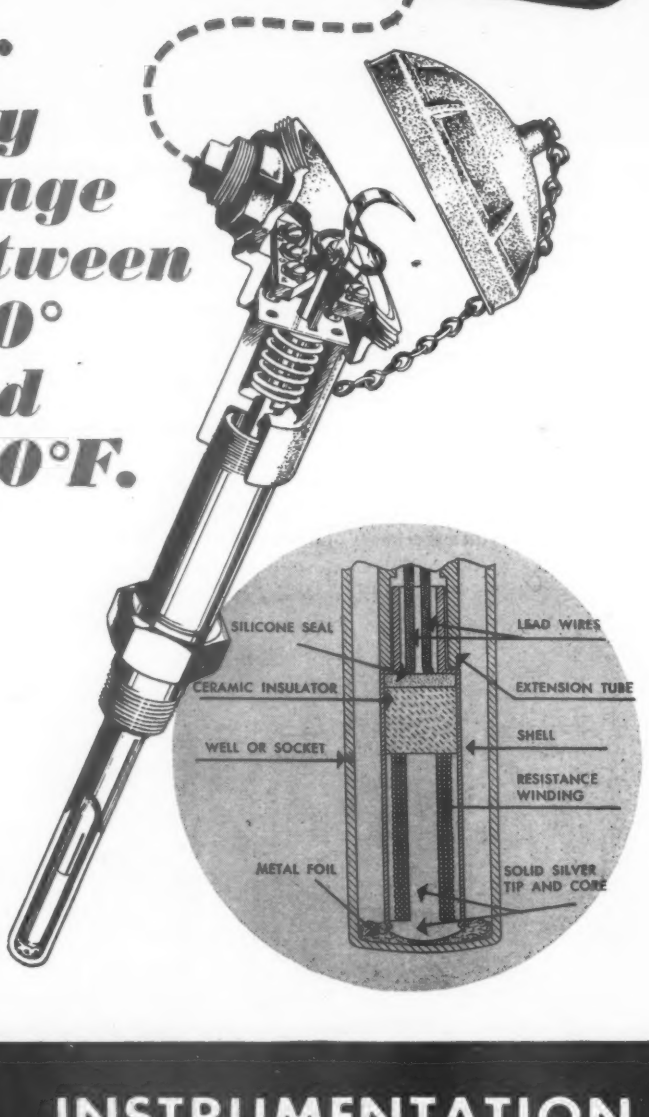

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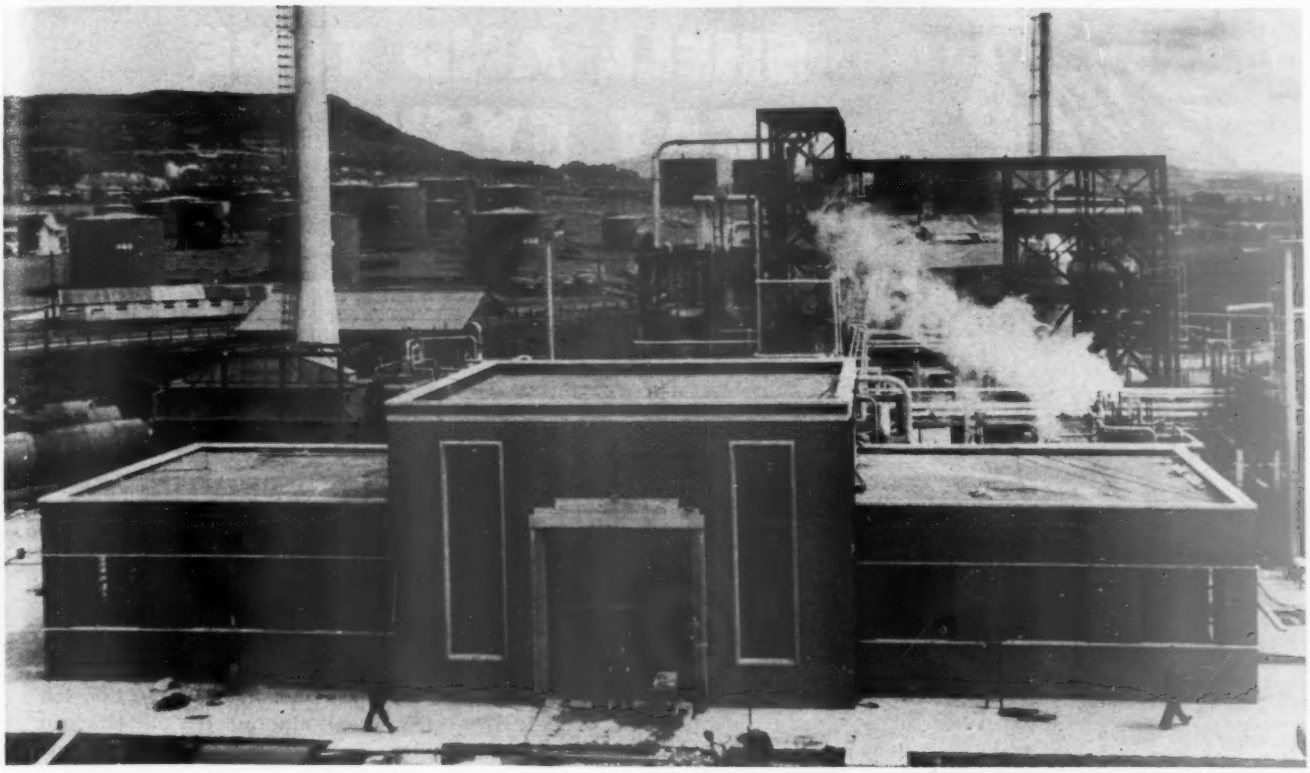

The autofiner seen from a position looking due north.

The Autofiner at Llandarcy

Catalytic desulfurization, via hydrogen sulfide, solves refiner's purification problem

V. S. SWAMINATHAN

A NEW type of refining unit, designated an autofiner, has been erected recently at Llandarcy. It is a plant for a catalytic desulfurization process with a capacity of 3500 bbl per stream day. In other words, it will take in, on an average, about 175,000 tons a year of oil containing naturally occurring sulfur compounds, and deliver almost as much of the same oil substantially free from that objectionable element.

This new process is an AIOC development covered by patents in the U. K., U. S. A. and several other countries, and the Llandarcy plant is the culmination of some years of research at Sunbury, first in the "test tube" stage and small "pilot plant" scale there, followed by some years of "pilot plant" operation on a much larger scale at the Grangemouth refinery in Scotland. The Llandarcy plant is 10 times the size of the Grangemouth pilot plant.

The autofiner at the National Oil Refineries in Llandarcy consists essentially of a furnace to heat the oil up to 750-800 F, a reaction vessel containing a catalyst that causes the desulfurizing action to take place at pressures of about 100 psi on this plant, and a gas system in which recycle gas is preheated in a small fixed heater before passing with the vaporized feed oil to the reactor.

The essence of the new process is that a small amount of gas consisting mainly of hydrogen, and known as recycle gas, is generated in the process and circulated continuously, removing sulfur in the oil by converting it into hydrogen sulfide, which is then destroyed by burning in the refinery furnaces. The process generates enough hydrogen to keep going economically without the need of that gas from an external source.

An exceptionally wide range of oils can have their sulfur content effectively removed in such plant; such oils range from spirit for motor fuel, white spirit for dry cleaners, vaporizing oil for farm tractors, gas oils for oil engines and light fuels for diesel engines.

EXCLUSIVE

The Llandarcy plant will normally operate to remove sulfur from white spirit and tractor vaporizing oil, and the preceding extended operations in the Grangemouth plant have fully proved the capacity of the process to produce very stable oils of good color, which are virtually odorless, without any subsequent treatment.

The cost of this first commercial autofiner unit at Llandarcy amounted nearly to £250,000 ($700,000), to which must be added the cost of linking it up to supplies of cooling water, fuel oil and electricity. This plant uses about 12,000 lb of steam per hour, 5600 lb per hour of which it makes itself, and calls for approximately 30,000 gal per hour of cooling water and a small quantity of electric power. It is designed to operate continuously except for occasional shutdown periods to regenerate the catalyst, or when changing over to treat another oil, or for periodic overhaul and maintenance. * * *

All SHELL AND TUBE ...HEAT EXCHANGERS by Vogt

ABOVE: View of new construction at Louisville Refining Company.

BELOW: Some of the many Shell and Tube Exchangers.

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Premium gasoline production has been boosted 20% from the same amount of oil charged since the Louisville Refining Company's new Catalytic Cracking Plant went on stream.

The new plant uses Vogt Shell and Tube Heat Exchangers exclusively and they make a significant contribution to the efficient and economic operations of this progressively modern refinery.

Vogt Shell and Tube Heat Exchangers are available in many different types, with fixed or removable tube bundles, to meet the special problem and specific operating conditions of each installation. They are constructed from carbon and special steels to meet every temperature, pressure, or vacuum service requirement.

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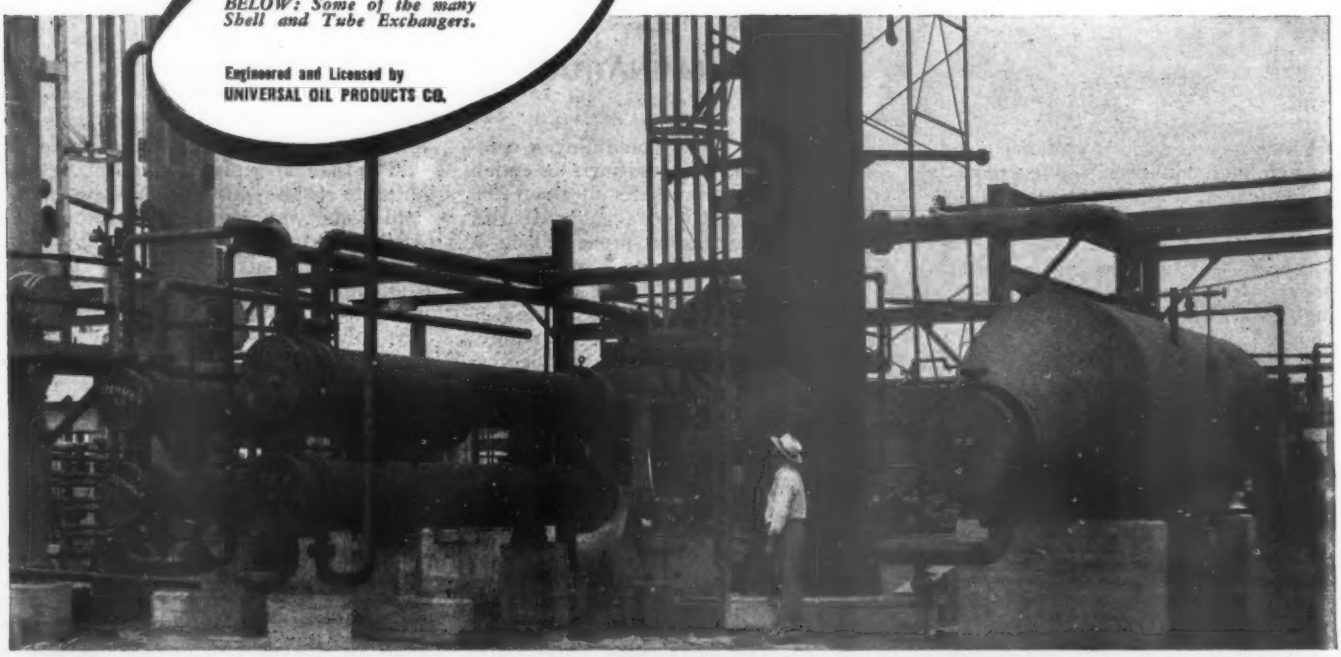

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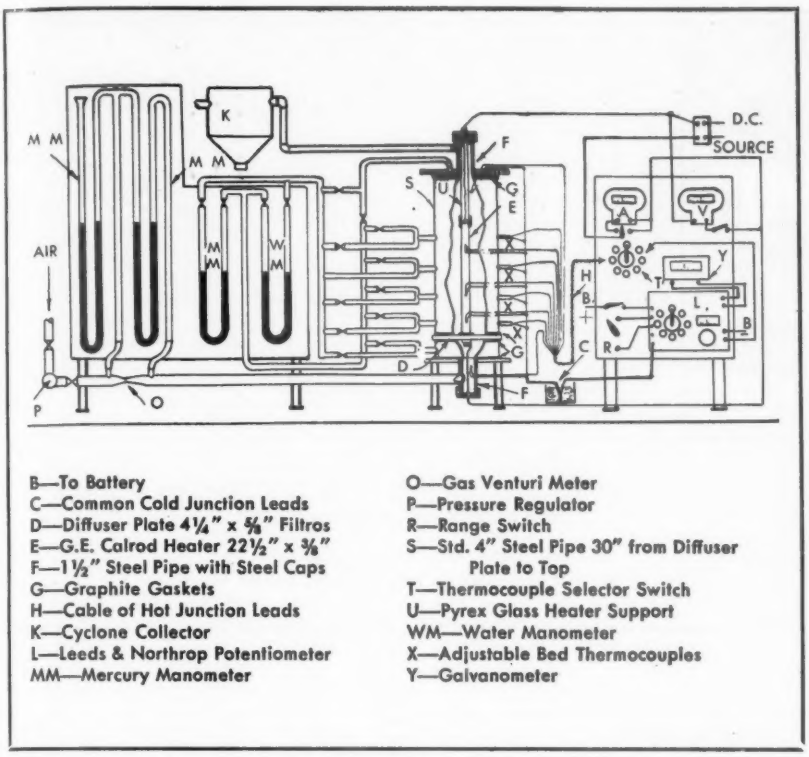


B—To Battery
C—Common Cold Junction Leads
D—Diffuser Plate 4¼" x ⅝" Filtros
E—G.E. Calrod Heater 22½" x ⅜"
F—1½" Steel Pipe with Steel Caps
G—Graphite Gaskets
H—Cable of Hot Junction Leads
K—Cyclone Collector
L—Leeds & Northrop Potentiometer
MM—Mercury Manometer
O—Gas Venturi Meter
P—Pressure Regulator
R—Range Switch
S—Std. 4" Steel Pipe 30" from Diffuser Plate to Top
T—Thermocouple Selector Switch
U—Pyrex Glass Heater Support
WM—Water Manometer
X—Adjustable Bed Thermocouples
Y—Galvanometer

FIG. 1. General layout of fluidization apparatus.

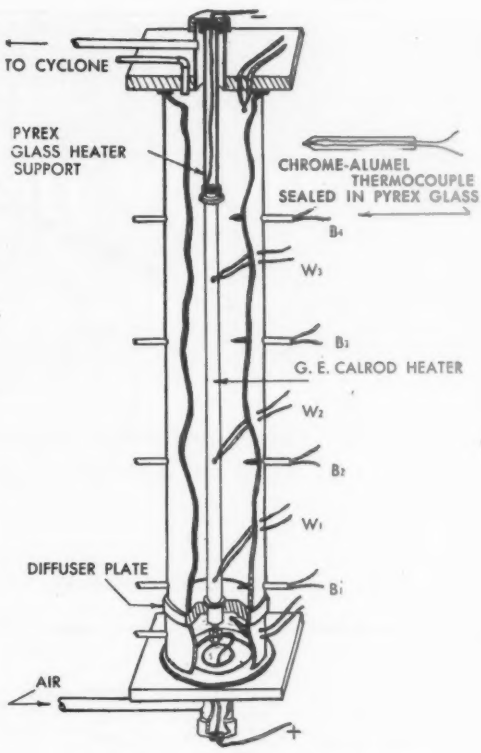


FIG. 2. Detail of tube and heater.

Heat Transfer and Fouling of Fluidized Beds

Heat transfer rate increased by coatings that reduce inter-particle friction — greater voidage decreases heat transfer

H. L. OLIN* and O. C. DEAN**

THE term "fouling" as used in this paper denotes the deposition of an adhesive layer on each separate granule of a system of finely divided solids. For example, a film of carbon on sands or on petroleum cracking catalysts, or of tar or wax under conditions where thermal decomposition does not go to completion, or wetting by the condensation of vapors. It is evident that fouling so defined may be produced artificially for experimental study.

Using sands of different screen sizes and aluminum silicate catalysts upon which various amounts of carbon, bakelite varnish or other foreign additives including sticky substances such as tars and waxes had been deposited, Olin and Patterson[1] studied the effects of such contaminants on the flow characteristics of fluidized beds. In general it was found that deviation from the normal behavior of the clean bed, for example, high increase in gas flow needed to bring about a given pressure drop, was due to the diversion of the gas stream into relatively large channels set up by adhesive agglomeration of the particles. By use of the Kozeny factor $\frac{\varepsilon^3}{(1-\varepsilon)^2}$ to correct for the voidage that resulted, good correlation of $\Delta p/L$ vs Re was obtained between clean beds and those even highly fouled. The purpose of the present work was to extend the study of contamination to its effect on heat transfer between an internally heated surface and the fluidized mass.

The plan of the apparatus used is shown in Figs. 1 and 2. It follows in general design that of Mickley and Trilling[2] who measured rates of heat transfer from hot surfaces to fluidized systems of glass beads (clean) ranging from .0178 to .0016 in. in diameter. Its main features are: A column of 4-in. steel pipe 30 in. long, machined inside to present a smooth surface; an axially placed G. E. "Calrod" heater with 22.5 in. of heating length; a venturi meter with appropriate mercury manometer for measuring air flow to the cylinder, and pressure taps spaced along the cylinder wall. Thermocouple junctions brazed to the heater to measure skin temperatures and adjustable junctions for the fluid mass are remotely con-

*Department of Chemical Engineering, University of Iowa, Iowa City, Iowa.
**Carbide and Carbon Chemicals Company, Oak Ridge, Tennessee.

EXCLUSIVE

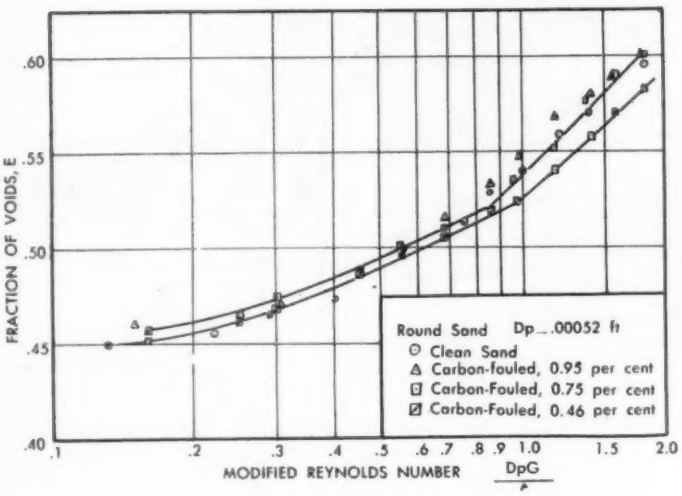


FIG. 3. Fraction of void as function of Re.

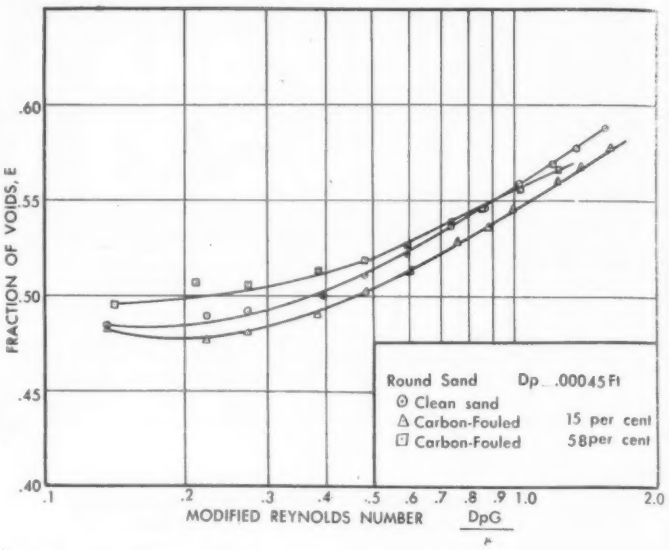


FIG. 4. Fraction of void as function of Re.

nected with a potentiometer. A glass cylinder of the same dimensions as the one described and similar to the one used in the earlier work[1] was set up and used to provide visual means for observing the behavior of the materials studied in this present series. It proved to be a valuable auxiliary in securing data for the calculation of voidage and pressure drops.

Bed Materials Used

Ottawa sand was chosen for use as the solid medium because of its close approximation to sphericity. Its Carman shape factor[3] was 0.95, its specific gravity 2.65. Careful classification provided three size grades: 80-100 mesh; 100-150, and 150-200. Average diameters of $39/10^5$, $45/10^5$, and $52/10^5$ ft, respectively, were computed by the common statistical methods with the aid of a microscope provided with a calibrated micrometer eyepiece. For the catalyst studies two lots of materials were chosen. A Davison Chemical Corporation silica-alumina, Grade F-1, was used in the fresh state. Regenerated and spent grades were obtained from those circulating in a cracking unit operated by the Pan American Refining Corporation, with carbon percentages of 0.5 and 1.0 respectively. Percentage distribution by diameter size was approximately, -20μ, 20; $20\mu - 40\mu$, 23; $40\mu - 80\mu$, 45; $+80\mu$, 12 per cent.

Only the sands coated with carbon films were studied extensively. Wax and tar covered particles used in the earlier work obviously were ruled out under conditions that involved temperatures at which such viscous organic substances would be cracked or otherwise modified. Bakelite coatings were used in a few runs but the electrostatic charges† acquired made results so erratic as to be useless for the purpose. The application of carbon was simply effected by immersion of the sands in solutions of asphalt in benzene, followed by heating in a closed chamber at 600-900 F for 36 hr. Gentle ball-milling and rescreening completed the preparation. Visual examination under the microscope showed that while uniformity of fouling was not perfect it was at least fair to good. The presence of the film did not measurably increase the particle diameter. As fouling tolerances of commercial catalysts are set at a maximum of one per cent this limit was adopted in our studies. Computation of carbon-film thickness of a sand used in a typical run comes up with a value of the order of 45Å — considerably more than monomolecular.

†Attempts to remove the electrostatic charges by subjecting them to the bombardment of gamma rays from Co^{60} were unsuccessful under the conditions of our experiments.

For each series of runs a clean or fouled sand (about 10 lb) or catalyst (about 3 lb) sufficient to cover the hot surface of the heater when the bed was expanded was charged into the steel column. Air was admitted at a moderate rate at first and the voltage and amperage of the heating current were regulated to maintain a constant energy input. On reaching the steady state variations in temperature of the turbulent bed both radially and longitudinally, were less than five degrees and the arithmetic mean was taken as the value of mean Δt. In the fixed bed range where temperature variations were much greater but not more than 12 deg the equation

$$t_{av} = \frac{\Sigma\, t\, D^2}{\Sigma\, D^2}$$

was used, where t is the Fahrenheit temperature and D the diameter of the annular space measured at the thermocouple position. If more than 12, a plot of temperature *vs* distance from heater wall was made and the average temperature estimated from

$$t_{av} = \frac{\int_0^D \Delta t\, dD}{\Delta D}$$

with aid of a planimeter. D is distance from the heater wall. The local heater wall coefficient h was calculated from

$$h = \frac{q}{A \int_{L_2}^{L_3} \Delta t\, dL}$$

where L_3 and L_2 are the heights of the beds at thermocouple stations 3 and 2 respectively. The constant heat input computed from voltage and amperage values was 4250 Btu per hour per square feet.

The following general observations on the flow behavior of the sands and catalysts used in the present work agree in the main with those made by Olin and Patterson in the earlier studies cited.

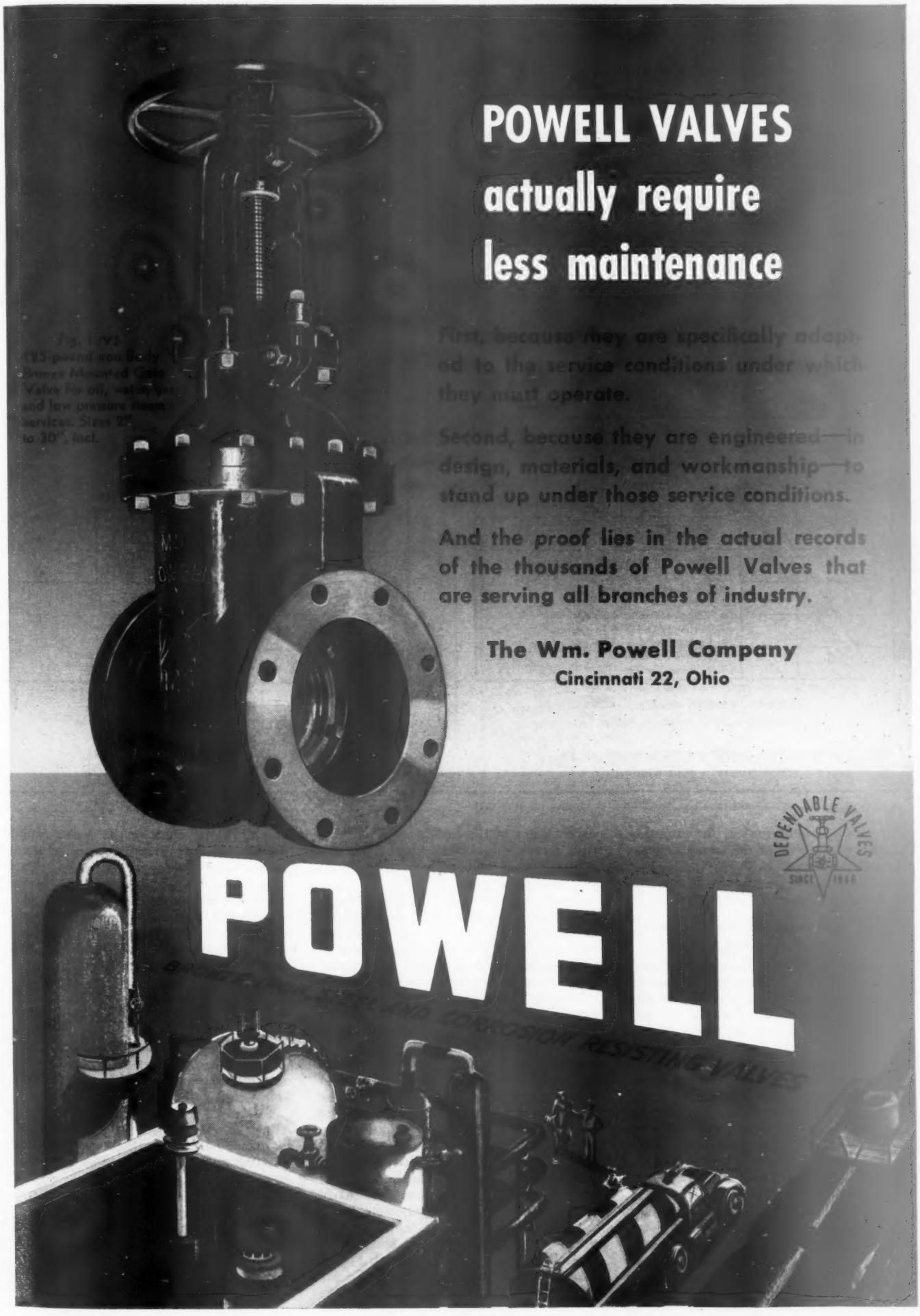
1. The flow rate required for initial fluidization was greater for the carbon-fouled sands than for the clean. This effect was even more pronounced with the bakelite-fouled material.

2. Complete turbulence is reached at a lower air rate with lightly-fouled sands than with clean, but at a higher degree of fouling the effect is reversed. Bakelite fouling sharply increases the air rate necessary for setting up bed circulation.

3. In general, the conditions that retard complete bed circulation promote slugging, which is aggravated by local adhesive forces. Other workers[4] have noted the same phenomenon. In certain cases electrostatic forces immobilize portions of the bed until pressures exerted on them mount to explosive values. Slugging is less, however, on lightly carbon-fouled sands than with the clean because of an apparent lubricative property that the carbon provides. No electrostatic effect was observed in connection with carbon films.

4. Initial fluidization of carbon-fouled catalysts occurred at lower values of air flow than with the clean. Microscopic examination showed that clean catalyst particles are sharp and non-spherical and spent and regenerated granules are somewhat rounded.

5. Channeling was found to be more pronounced in beds of small particles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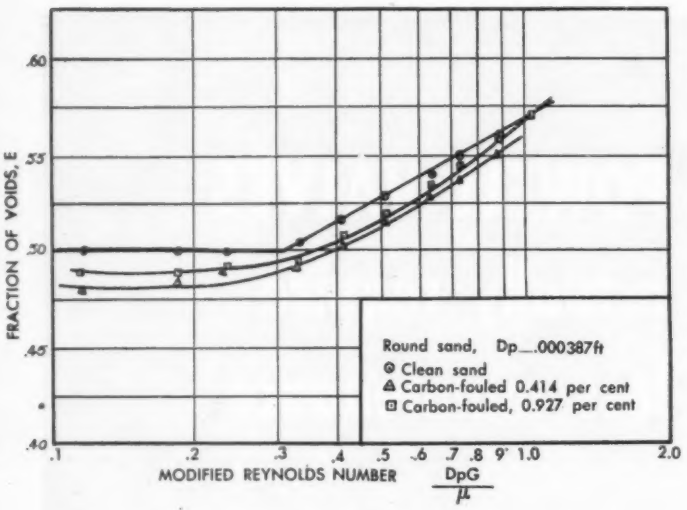

FIG. 5. Fraction of void as function of Re.

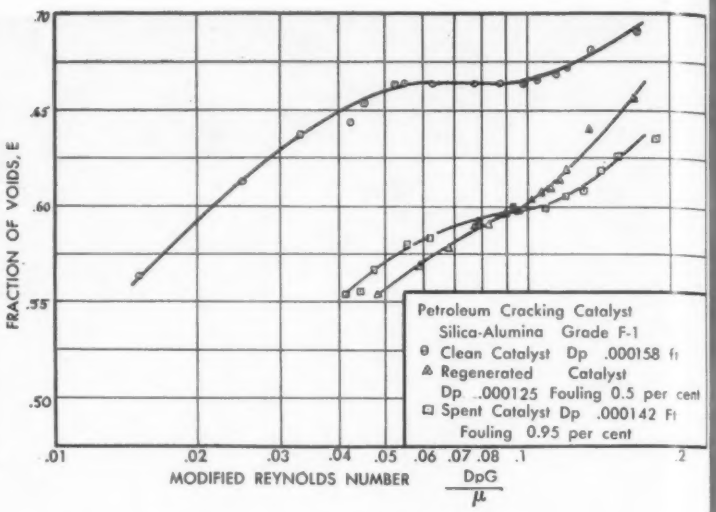
FRACTION OF VOIDS, E
MODIFIED REYNOLDS NUMBER DpG/μ
Petroleum Cracking Catalyst
Silica-Alumina Grade F-1
Clean Catalyst Dp .000158 ft
Regenerated Catalyst
Dp ..000125 Fouling 0.5 per cent
Spent Catalyst Dp .000142 Ft
Fouling 0.95 per cent

FIG. 6. Fraction of void as function of Re.

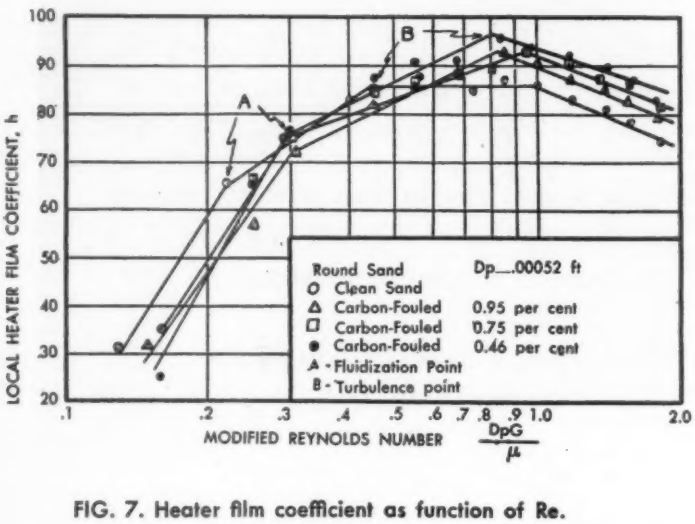

FIG. 7. Heater film coefficient as function of Re.

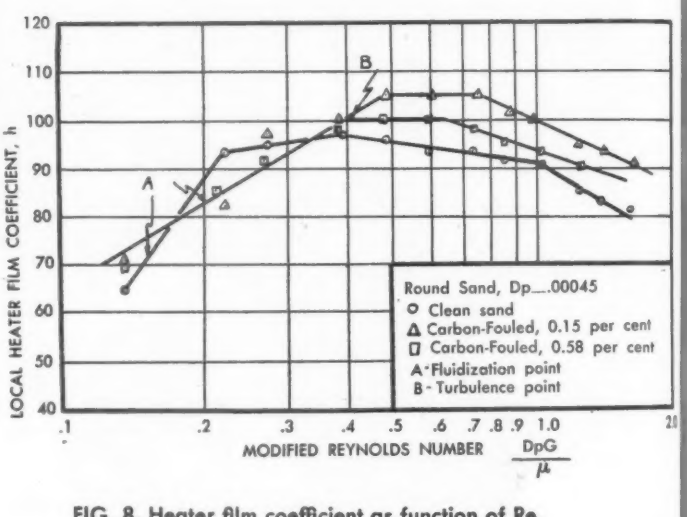

FIG. 8. Heater film coefficient as function of Re.

and in those highly fouled, due probably to the formation of loose aggregates through interparticle forces.

6. A decrease in friction factor was observed in the case of the fouled sands.

Bed Voidage as a Function of Fouling

In order to provide means for visual observation the measurement of voids in the fluidized beds under study in this work was made with the use of an auxiliary cylinder having the same dimensions as the steel tube chosen for the thermal studies. Operating conditions with respect to amount and size of granular solids, rate of air flow and other variables were similar to those of the main investigation except that the temperatures maintained were necessarily lower. Collateral tests, however, had indicated that in the lower ranges at least the effect of temperature on voidage was of minor importance if not negligible and the data presented are based on that assumption. Following the suggestion of Wilhelm and Kwauk[5] voidage was computed from the expression $1 - L_o/L$ where L is the visually measured height of the bed at a definite air rate, L_o the height of a hypothetical bed containing no voids and L_o/L the solids concentration.

In Figs. 3, 4, 5, and 6 are shown the values of fraction of void as functions of the modified *Re*. In sharp contrast with the results of Olin and Patterson on granules fouled with waxy or gummy substances the carbon-coated sands are relatively free-flowing and the family of curves resulting from a series of tests on a given grain size make up, in the main, sets of compact bundles. Referring to Fig. 3 complete bed circulation begins at *Re* 0.5 for clean sand and at 0.35 and 0.45 for the fouled in the order of degree of thickness of coating. At *Re* 0.8 slug flow begins, wherein large bubbles of gas raise sections of the bed and then drop them suddenly. Bed expansion increases more rapidly with flow and both the clean and the more heavily fouled sands are affected more than those lightly covered. In the main, the foregoing comments apply as well to Figs. 4 and 5. In the case of Fig. 4 smooth fluidization occurs up to *Re* 0.7 and there is less difference in voidage in the higher than in the lower range. In the slug-flow range both fouled sands have lower voidages than the clean. Fig. 6 shows the characteristic behavior of catalysts under different conditions in the smooth fluidization and the slug-flow ranges. All catalysts of this kind are similarly affected by increase in flow and fouled catalysts exhibit lower voidages in all ranges.

A plausible explanation of the lower voidages of the lightly-fouled sands is that the carbon-coated particle offers less frictional resistance to the air stream and therefore is not so readily separated from its neighbor by the frictional drag of the current.

Local Heater Film-coefficient

Figs. 7, 8, 9, and 10 present the data relating the local heater film-coefficient to degree of fouling. In general the presence of a carbon film on the sand retards heat transfer across the wall film in the fixed bed range and in the lower flows of smooth fluidization. If the course of a given sand is followed through the range of flow it is seen that *h* increases rapidly to a maximum, levels off in the range

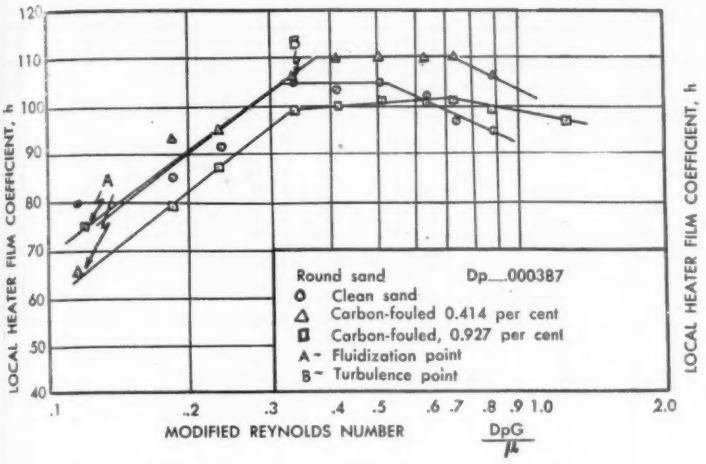

FIG. 9. Heater film coefficient as function of Re.

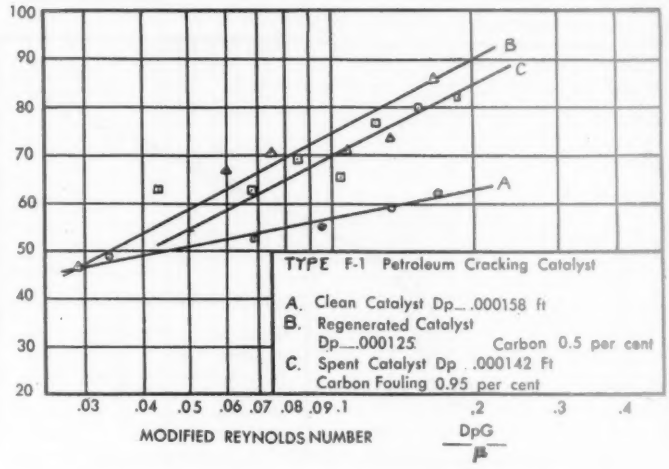
LOCAL HEATER FILM COEFFICIENT, h
MODIFIED REYNOLDS NUMBER
DpG/μ
TYPE F-1 Petroleum Cracking Catalyst
A. Clean Catalyst Dp... .000158 ft
B. Regenerated Catalyst Dp....000125 Carbon 0.5 per cent
C. Spent Catalyst Dp .000142 Ft Carbon Fouling 0.95 per cent

FIG. 10. Heater film coefficient as function of Re.

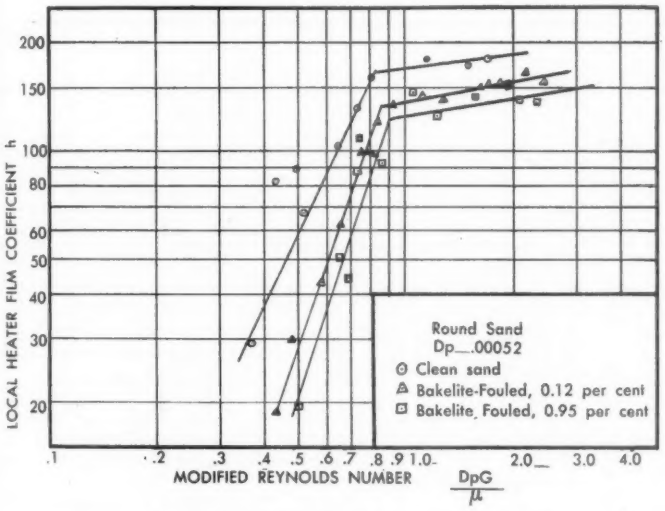

FIG. 11. Heater film coefficient as function of Re.

List of Symbols Used

D_p = particle diameter, equivalent to diameter of sphere of equal diameter, ft.
G = mass velocity of fluid, based on empty vessel, lb/(sq ft) (sec).
h = heater wall coefficient, Btu/(sq ft) (hr) (°F).
k_f = thermal conductivity of air film surrounding heater, Btu/(sq ft) (hr) (°F).
L = height of bed at any instant, ft.
L_o = height of bed free of voids, ft.
Re = modified Reynolds number, D_pG/μ.
$\triangle P_o$ = observed pressure drop, lb/sq ft.
$\triangle P_c$ = pressure drop computed from the weight of the bed, lb/sq ft.
ε = void factor, dimensionless, equal to $L - L_o/L$.
μ = fluid viscosity, lb/ (sec) (ft).
ρM = solids concentration in fluidized mixture, lb/cu ft.

of complete bed flow up to the slugging point and finally, decreases in the range of slug disturbance. We may rationalize these observations by postulating two phenomena, both functions of flow rate, but with opposite effects on the value of *h*. The first is individual particle motion that tends to disrupt the heater wall film and so to increase rate of transfer. The second, with negative effect, is a function of ε, viz., the solids concentration $(1-\varepsilon)$, which at the higher flows becomes the critical factor. Within the range studied the catalysts do not exhibit so sharp an increase in voidage with increase of *Re* and the curves of Fig. 10 do not exhibit the characteristic break of those for sands. The negative effect of fouling on *h* in the flows below complete bed circulation may be explained by their possession of a rougher surface than clean or lightly fouled sands and they consequently set up a greater resistance to the air stream. As flow increases fluid friction becomes less significant as it is inversely proportional to the square of G, and interparticle friction assumes critical importance. The curve intersections exhibited in Figs. 7, 8, and 9, at the points of complete bed circulation indicate that particle motion of clean sands is retarded more than that of the fouled. Fig. 10 for the catalysts indicates that a similar phenomenon would show up if the curve were extrapolated to lower flows. The sharp breaks in the curves at *Re* 0.8 for bakelite fouling, Fig. 11, occurs at the point of transition from smooth fluidization to slug flow. The marked effect of the presence of surface contamination on the value of *h* may be attributed to the electrostatic effects that bring about an accumulation of solids on the heater wall, easily removed with a brush.

Apparent Viscosities of Sand Beds

As the flow behavior of fouled sands indicated that the carbon film served in many cases as a lubricant to reduce interparticle friction, special attention was directed to the verification of this hypothesis. The sands under test were fluidized in a vertical tube at an air rate sufficiently high to provide complete mixing. Near the bottom of the tube an orifice was provided through which the sand flowed laterally while convection was maintained. The unit of comparison was the time required for the escape of 70 g of the material. This procedure was ineffective, however, in the case of the finely divided catalysts because the data obtained were too erratic to be significant. The results shown in Table 1 are not highly conclusive but they do

TABLE 1. Gravity flow characteristics of sands.

Run	Dp, ft/10⁶	Per cent fouling	70 g flow sec	g/sec
1.....	520	0.00	6.9	10.15
2.....	520	0.95	6.6	10.6
3.....	520	0.75	6.3	11.1
4.....	520	0.46	6.3	11.1
5.....	450	0.00	6.9	10.15
6.....	450	0.18	5.6	12.5
7.....	450	0.58	6.5	10.8
8.....	387	0.00	6.2	11.3
9.....	387	0.41	5.8	12.1
10.....	387	0.93	6.3	11.1
11.....	520	0.12*	6.9	10.15
12.....	520	0.95*	6.5	10.8

* Bakelite fouled.

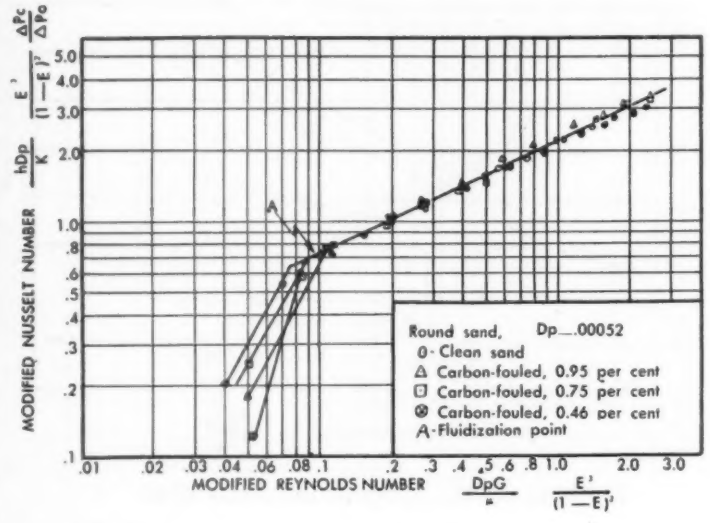

FIG. 12. Modified Nusselt vs modified Re (Kozeny).

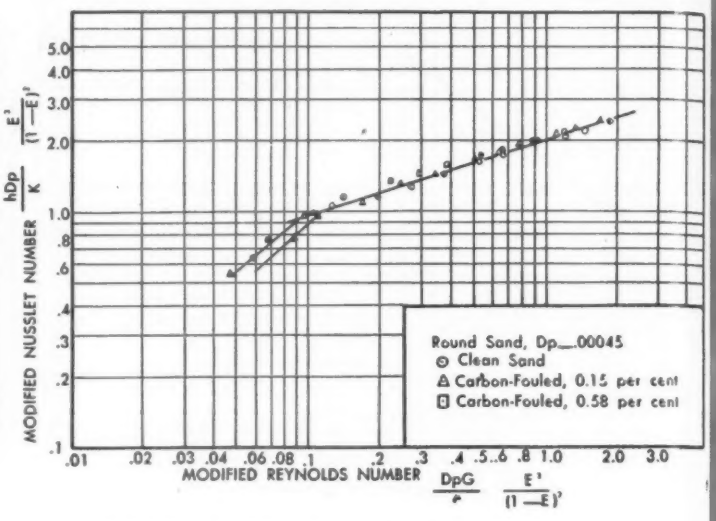

FIG. 13. Modified Nusselt vs modified Re (Kozeny).

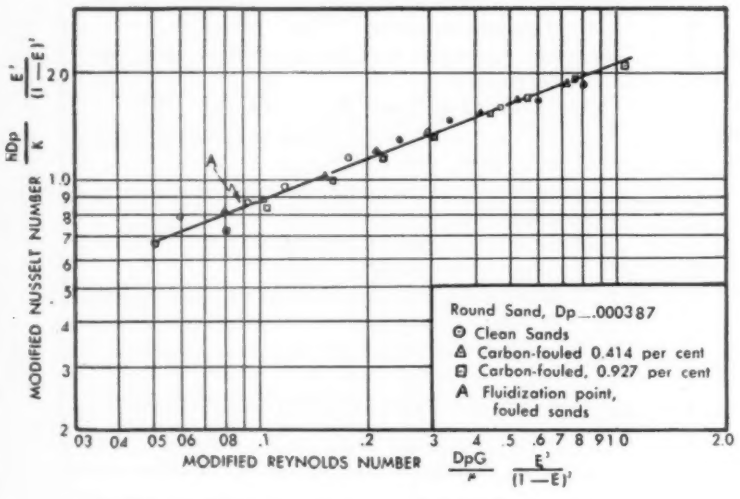

FIG. 14. Modified Nusselt vs modified Re (Kozeny).

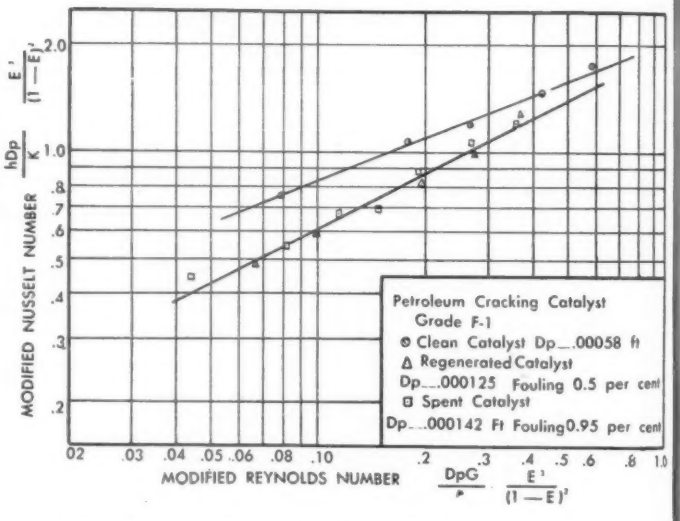

FIG. 15. Modified Nusselt vs modified Re (Kozeny).

indicate at least a minor lubricative effect and they show in any case that the carbon deposit is free from tackiness.

General Correlation of Data

The general equation

$$(1)\quad \frac{(hD_p/k_f)^a\ (c_p\mu/k_f)^b}{(D_pG/\mu)^c} = \Psi$$

was used in correlating the data of Figures 7, 8, 9 and 10. D_p in each parameter was multiplied by the Kozeny function $\frac{\varepsilon^3}{(1-\varepsilon)^2}$ to correct particle diameter to actual channel diameters with variations in voidage. As air was the only fluidizing gas used the Prandtl was considered constant at the temperatures and pressures employed and it was therefore merged with the coefficient of *Re*. From the log-log plot of hD_p/k_f vs. D_pG/μ the constant exponents a, b and c were readily determined and the general correlation equation became

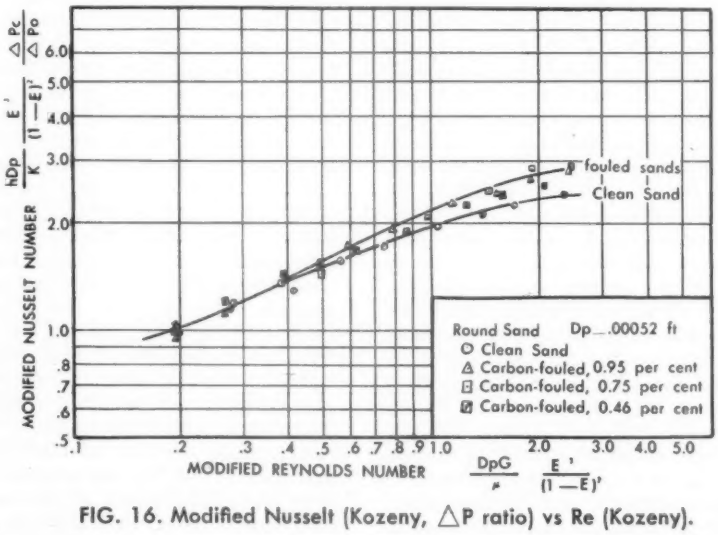

FIG. 16. Modified Nusselt (Kozeny, △P ratio) vs Re (Kozeny).

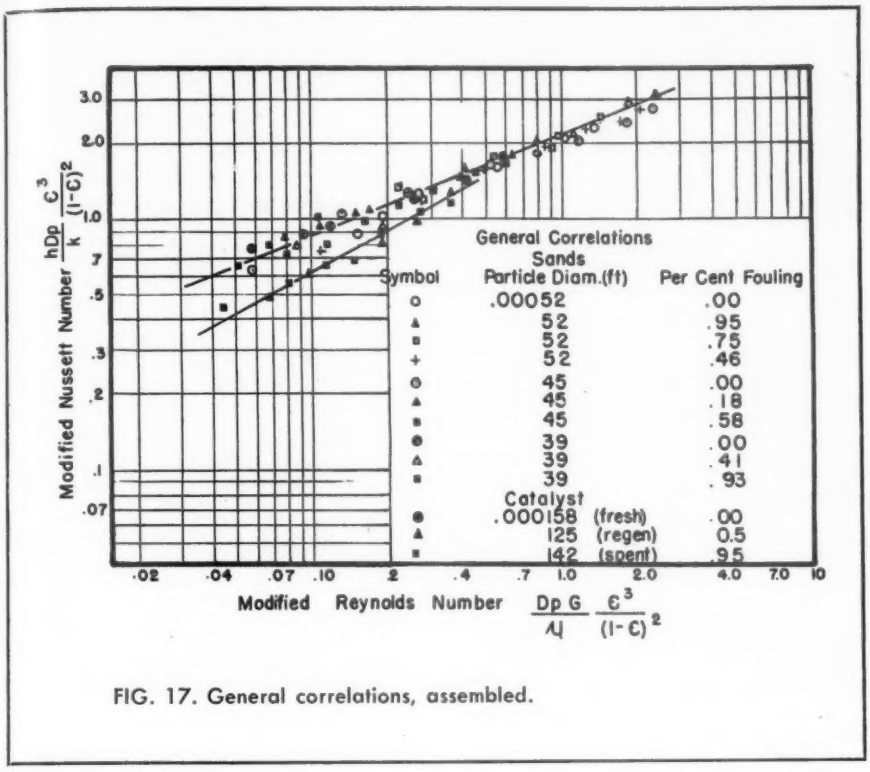

FIG. 17. General correlations, assembled.

TABLE 2. Typical heat transfer data (Ottawa sands).

No.	G	h	Re	ε	$\frac{\varepsilon^3}{(1-\varepsilon)^2}$	$\Delta P_o/\Delta P_c$
		D_p, 45/10^5 ft; fouling, zero.				
1	165.0	81.1	1.55	.588	1.195	1.020
2	130.0	85.0	1.21	.569	0.990	1.002
3	79.1	93.4	0.73	.536	0.717	0.978
4	42.8	96.7	0.39	.500	0.500	0.972
5	15.1	64.5	0.14	.484	0.430	0.985
		D_p, 45/10^5 ft; fouling, 018%				
6	166.0	90.6	1.58	.577	1.072	1.010
7	131.0	94.5	1.22	.560	0.903	1.004
8	65.2	105.0	0.60	.513	0.570	.984
9	42.0	100.0	0.38	.490	0.450	.977
10	15.1	70.4	0.14	.462	0.341	.979
		D_p, 45/10^5 ft; fouling, 0.58%				
11	131.0	90.0	1.23	.566	.962	1.006
12	79.7	98.0	0.73	.538	.775	.986
13	52.4	100.0	.48	.519	.607	.978
14	29.7	91.5	.27	.505	.525	.980
15	15.2	70.0	.14	.495	.475	.979

TABLE 3. Typical heat transfer data (petroleum cracking catalysts).

No.	G	h	Re	ε	$\frac{\varepsilon^3}{(1-\varepsilon)^2}$	$\Delta P_o/\Delta P_c$
		D_p, 158/10^6 ft; fouling, zero (fresh).				
1	52.8	62.0	.169	.690	3.43	.856
2	42.8	59.0	.136	.680	3.08	.856
3	30.4	54.5	.096	.670	2.75	.856
4	22.0	52.8	.069	.664	2.58	.856
5	11.1	48.8	.034	.640	2.00	.723
		D_p, 125/10^6 ft; fouling, 0.5% (regenerated).				
6	64.7	86.0	.166	.656	2.20	.930
7	53.3	73.5	.134	.640	2.02	.945
8	43.4	70.5	.108	.623	1.80	.966
9	30.2	70.5	.075	.598	1.32	.942
10	24.1	66.7	.060	.582	1.12	.942
		D_p, 142/10^6 ft; fouling, 0.95% (spent).				
11	64.5	82.0	.186	.635	1.91	.940
12	53.3	80.0	.154	.625	1.73	.960
13	43.2	76.3	.124	.613	1.53	.980
14	36.2	65.5	.104	.605	1.42	.995
15	30.2	69.0	.086	.598	1.32	.985
16	24.0	62.3	.068	.588	1.20	.968
17	15.3	62.3	.043	.570	1.00	.936

$$(2)\quad hD_p/k_f \frac{\varepsilon^3}{(1-\varepsilon)^2} = 2.15\, D_pG/\mu \frac{\varepsilon^3}{(1-\varepsilon)^2}$$

from which the value of h takes the form of

$$(3)\quad h = 2.15\, k_f\, [G/\mu]^{0.391} \left[D_p \frac{\varepsilon^3}{(1-\varepsilon)^2}\right]^{-0.609}$$

Plots for the various materials are shown in Figs. 12, 13, 14, and 15. From Fig. 15 it may be seen that the curve for fouled catalysts deviates from that of the fresh, due to the higher tendency of the former to agglomerate. Thus the effective diameter of the particle should be greater than the individual diameter. The corresponding value of h is

$$(4)\quad h = 2.21\, k_f\, [G/\mu]^{0.547} \left[D_p \frac{\varepsilon^3}{(1-\varepsilon)^2}\right]^{-0.453}$$

Comparing Figs. 12 to 15 with those of 7 to 10 it is seen that the Kozeny function eliminates variations in the heat transfer coefficient due to variations in voidage (or solids concentration) noted in the different flow zones, and the effects of fouling and air flow on the value of h stand out prominently. Close examination reveals, however, that clean sands tend to deviate slightly in the negative direction from the main correlation. As the ratio of observed pressure drop ΔP_o to the calculated value ΔP_c was found to be approximately inversely proportional to the degree of fouling the correction factor $\Delta P_o/\Delta P_c$ was applied in the case of the larger sands, with the result shown in Fig. 16. Improvement in correlation is evident. The data of Figs. 12 to 15 are assembled and summarized in Fig. 17.

In Tables 2 and 3 are presented typical data observed and computed in the course of the work, on which the graphs shown are based. The complete series (29 tables) is included in the thesis submitted by the junior author in partial fulfillment of the requirements for the PhD degree.[6]

Correlation of Data of Mickley and Trilling

The similarity of apparatus and method of the present study with that of Mickley and Trilling[2] suggested the correlating of the results obtained in the two studies. Recalling that these workers used glass beads up to 0.0178-in. in diameter, 15/ 10^4 ft, as the fluidization mass as compared with our sands ranging from 39/ 10^5 to 52/ 10^5 ft and cracking catalysts from 125/10^6 to 158/10^6 ft it is obvious that the dimensions of the two sets of materials are of different orders of magnitude. As a result, physical conditions imposed limiting values of Reynolds numbers upon us far below those that were available to Mickley and Trilling. The highest values of *Re* we employed, beyond which our materials would have been

blown from the cylinder, are about equal to the lowest of theirs.

A liberal random sampling of the M. and T. data (65 points) plotted with the parameters of our Fig. 17 is shown in Fig. 18. In comparing these two plots it should be noted that voidage data on which Fig. 18 is based were computed from pressure drops while ours were derived from measured bed heights.

In correlating their heat transfer data on internally heated beds Mickley and Trilling plotted h versus functions of ρM (solids concentration) and D_p as a parameter in the form of $\rho^2 M/D_p^3$. The regularity of the curve they obtained (their Fig. 17) led them to conclude that (1) the local heat transfer coefficient for each size group increases as a power function of solids concentration M, and (2) that with internally heated beds the coefficient is very nearly independent of mass velocity G.

In comparing our Fig. 17 that summarizes our data, with Fig. 18 in which the same parameters are applied to the data of Mickley and Trilling a marked similarity is evident. Despite the large differences in *Re* range of the two studies the use of the modified Nusselt and Reynolds numbers puts into play in both sets of data similar factors affecting heat transfer. The Kozeny voidage function that we use to correct D_p to actual channel diameters in the expanding bed replaces the solids concentration function ρM, an important factor in the Mickley-Trilling correlation. At the same time our use of *Re* introduces a function that increases with G, that is, heat transfer with internal heating *does* seem to be affected by the mass velocity of air. We conclude, therefore, that in addition to solids concentration, the mass velocity G is significant. In the rational analysis of course, the governing factors are the frequencies and kinetic energies of impingement of solid particles upon the air film, obviously functions of G, a view supported by our observation that carbon film lubrication raises the value of h.

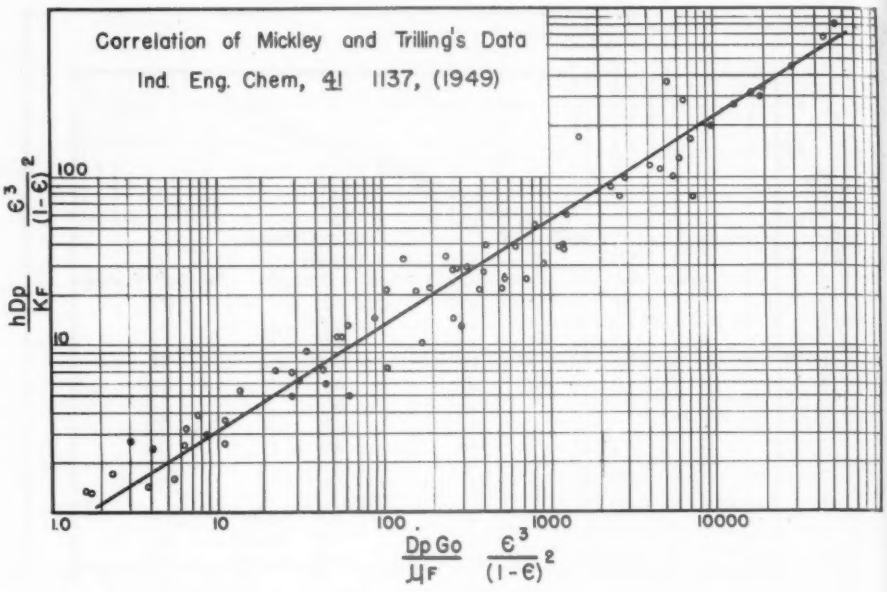

FIG. 18. Correlation of Mickley and Trilling's data.

Summary and Conclusions

1. Variation in heat transfer in beds of particles fluidized with air appears to be a direct function of particle motion and an inverse function of voidage for a given solid. Three types of bed motion are observed as the air-flow rate is increased: Initial accelerated particle motion, smooth fluidization, and finally, slug flow. Heat transfer is at its maximum in the upper range of smooth fluidization.

2. The effects of fouling on heat transfer appear to be proportional to the influence such fouling exerts on particle motion and voidage. If interparticle friction is decreased by the surface coating heat transfer is improved in the two upper ranges of flow but if greater voidage results the opposite effect is observed. Thin carbon films act as lubricants to decrease voidage, and so to promote heat transfer. Bakelite or other dielectric coatings on the other hand although primarily smooth and dry take on electrostatic charges that not only disturb the orderly flow of the solid granules but set up stagnant patches of insulating material on the heater wall.

3. At air current rates above the smooth flow range the retardation of motion of the particle of rougher surface is reflected in an increase of the ratio $\Delta P_o/\Delta P_c$.

4. Values of h, the film coefficient for sands, ranged from 65 to 105; for catalysts, from 50 to 86.

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6. Dean, O. C. Thesis. *Univ. of Iowa Library*, T 1952, D 282, 117 pp.

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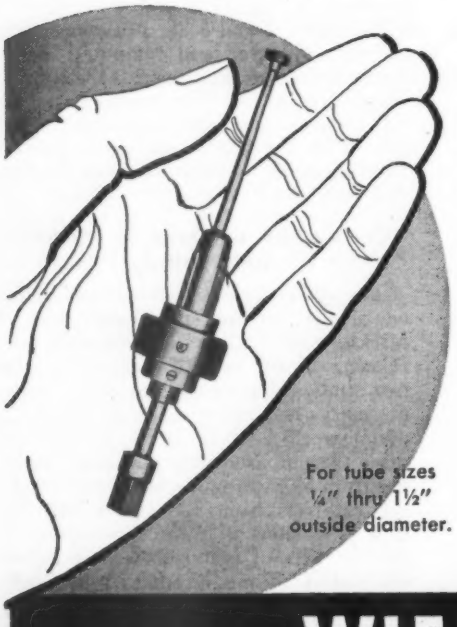

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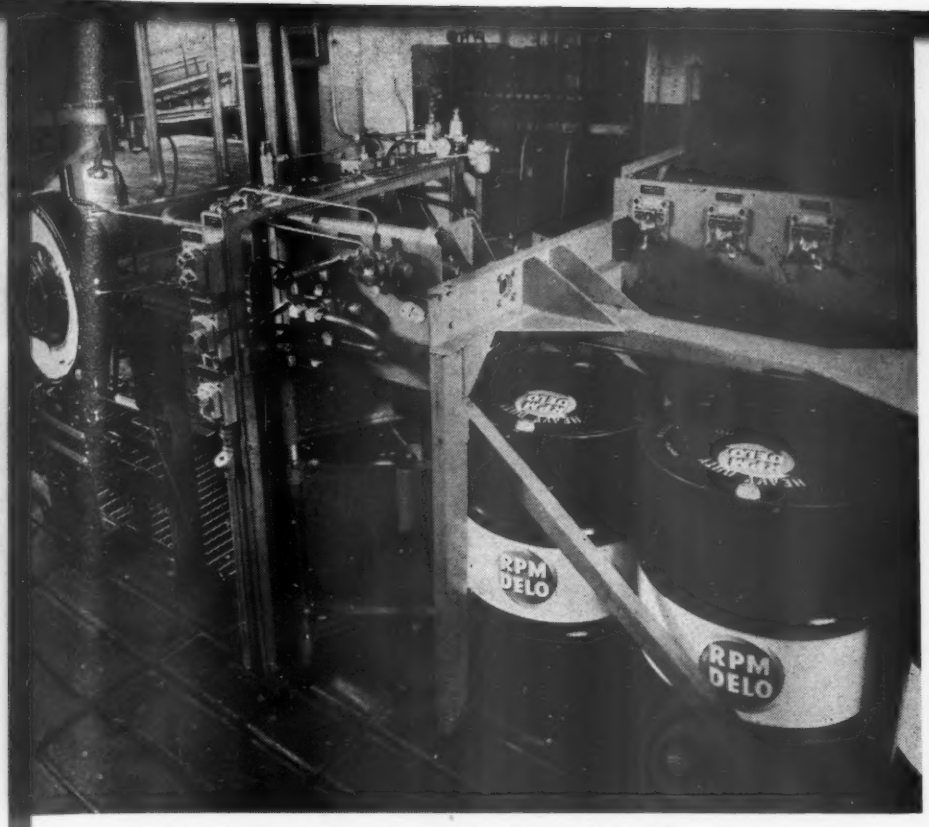


Empty drums arriving at upstream end of automatic drum filler. Roller gates admit one drum at a time to the bung locating station.

Automatic Drum Filler Cuts Costs

Unit in use at Standard California refinery can fill 1000 drums of 53 gal per 8-hour shift with single operator

BRUCE MacDONALD*

DEVELOPMENT of an automatic drum filler was initiated in the Engineering Designs Group at Standard Oil Company of California's Richmond refinery. The machine was jointly invented and developed by A. S. Guerard, assistant chief engineer, and his assistants, R. P. Ranney, D. H. Reese, and B. MacDonald, and is the subject of patent applications.

An experimental unit was first completed and installed in the laboratory for extensive pilot run testing. After improvements and modifications were made, the unit was installed in the lube filling line in Standard's Richmond refinery.

Objectives

At the start of the project, the following objectives were set up:

1. Elimination of the need for an operator during the entire filling cycle, when his useful work is performed only at the start and finish of the cycle.

2. Accomplish a major reduction in the length of the filling cycle.

Problems

Probably the biggest single problem in connection with this project was the non-uniformity of the drums in use today. Automatic filling in small containers (one quart, one gallon, 5 gallons, etc.) has been accomplished for many years largely because the containers are all new and of uniform size when filled.

In drum filling such is not the case. Drum heights vary as much as several inches, and diameters vary as much as two inches, and the bung offset distance from the edge or chine of the drum also varies one to two inches. Even if a major operator decided to make the tremenddous initial investment of scrapping all of his existing drums, replacing them with new and uniform sized drums, returnable empties would be coming back to his plant in large daily quantities for a period of several years, causing continual confusion.

Another problem, which is really an offshoot of the non-uniformity just discussed, is the fact that empty drum weights vary as much as six or seven pounds, in the majority (exceeding 95 per cent) of drums, but considerably more in cases of extreme irregularity. If the human factor were to be eliminated in the drum filling operation, then the human's ability to see and account for the tare weight of the empty drum had to be supplanted with a piece of automatic equipment.

In meeting the objective of achieving a major reduction in the length of the filling cycle, a third problem was encountered—that of "foaming" in lubricating oils. When filled from a nozzle at the top of the drum at a high rate, these oils frequently foam to such an extent that the drum cannot be filled to the required net weight without waiting for the oil to settle down. This condition varies with the type of oil, the temperature and the filling rate, but experience in the past has been that an operator filling drums from a nozzle at the top of the drum would require an average of one minute to fill and handle a drum.

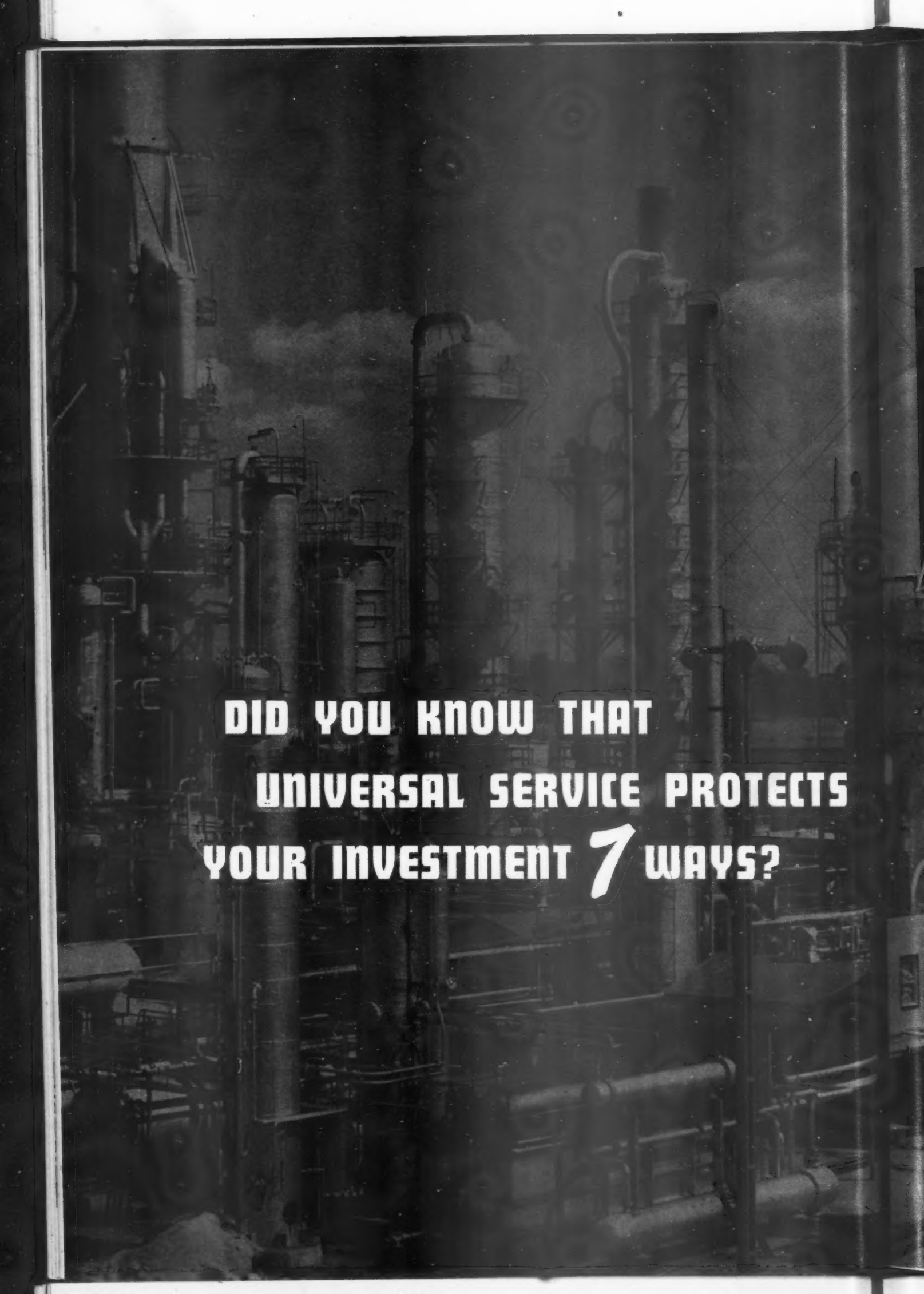
Solution

The solution of these problems resulted in the design of a two-station machine that could be placed in a gravity roller conveyor line. The upstream or first station is the bung locating device. This station consists of two pairs of rolls or "gates" that bear on the top chine of the drum. These gates, actuated by hydraulic cylinders, meter empty drums one at a time as needed into the machine, hold the drum in place, and rotate it slowly. When a drum is in position in this station, an overhead carriage lowers to the top of the drum. A component of the carriage is a finger that rides along the top of the drum as the drum rotates. When the drum has rotated until the bung comes into a position on the centerline of the conveyor, the finger drop in. This action, through a mechanical linkage, sends a signal through the control circuit to stop the rotation of the drum and to open the downstream gate for movement of the drum forward to the second station, which is the filling scale.

The filling operation on the previous drum has been proceeding simultaneously with the bung locating operation just described. When the control circuit receives the proper signal indicating that the previous drum has been filled, the overhead carriage at the bung locating station moves forward, simultaneously pushing the full drum off the filling scale and pulling the next drum onto the filling scale. When the next drum is in position on the scale, the overhead carriage raises and retracts to its original position at station (1) to locate the bung of the next drum. The filling lance lowers into the drum on the filling scale, beginning the flow of oil when it reaches the bottom of its stroke. The filling rate

*Senior engineer, The Rucker Company, Oakland, California.

EXCLUSIVE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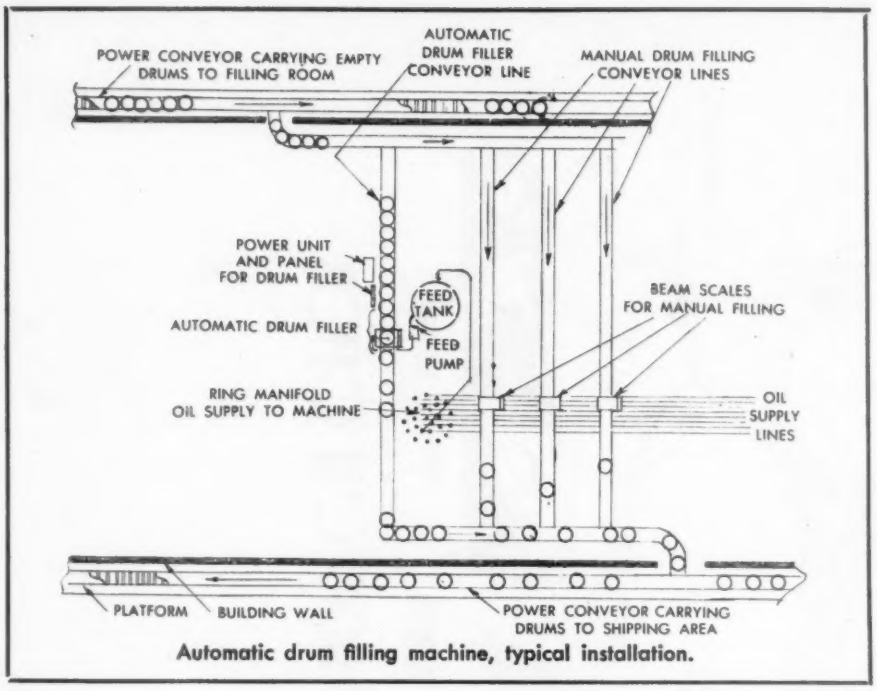
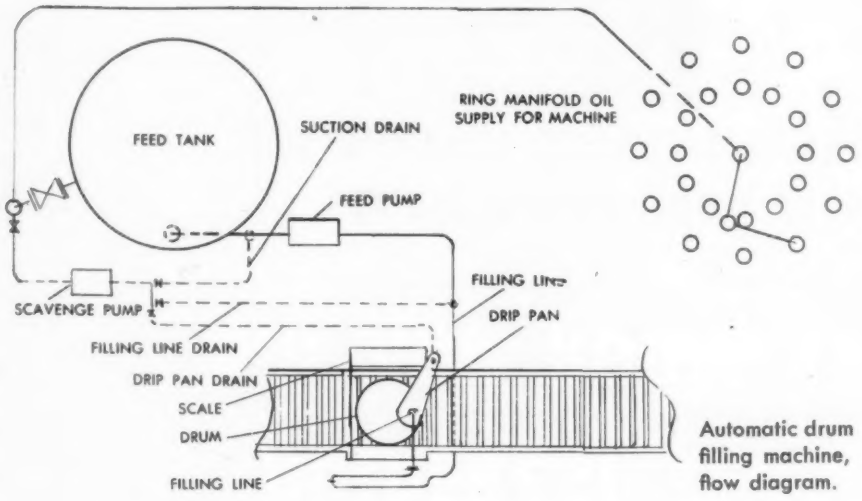

POWER CONVEYOR CARRYING EMPTY DRUMS TO FILLING ROOM
AUTOMATIC DRUM FILLER CONVEYOR LINE
MANUAL DRUM FILLING CONVEYOR LINES
POWER UNIT AND PANEL FOR DRUM FILLER
AUTOMATIC DRUM FILLER
FEED TANK
FEED PUMP
BEAM SCALES FOR MANUAL FILLING
RING MANIFOLD OIL SUPPLY TO MACHINE
OIL SUPPLY LINES
PLATFORM
BUILDING WALL
POWER CONVEYOR CARRYING DRUMS TO SHIPPING AREA

Automatic drum filling machine, typical installation.



Automatic drum filling machine, flow diagram.

At bung locating station, powered roller gates revolve drum until locating "finger" drops into open bung. This actuates a signal, which stops revolving rollers and clears control interlock for movement of drum to next station. Locator carriage advances drum to filling station, then retracts to locate bung on next drum.

At the filling station, empty drum with open bung positioned under lance rests on scale platform. Lance descends and foot valve opens as lance tip approaches bottom of drum. Oil is pumped at full volume until scale signals approach to final weight; oil flow is cut down until exact net weight is reached, and then shut off.

is about 225 gal per minute and in a few seconds the tip of the lance is submerged and continues so until the drum is filled, thus minimizing foaming. Automatic cut-off is achieved in two steps by the filling scale. When the scale indicates proper net weight, less several pounds, the full oil flow is cut down to a dribble. When a second indication is received of correct net weight, complete cut-off is made. The filling lance withdraws from the drum and, upon reaching the top of its stroke, gives a signal to have a drip pan swung beneath it to keep the tops of the drums clean. The full drum is now ready to be pushed from the scale and the entire cycle repeats.

Without going into extreme detail of every single small operation, the above has described the machine's essential sequence of operations.

As to the problems discussed earlier:

1. The non-uniformity of drums required the design to be flexible enough to handle as many drums as possible. As one might expect, the cost of the design and development rises logarithmically the more variations of drum dimension for which you design. A practical limit had to be established to keep development costs within reason. These limits were set roughly as follows:

   A. Drum height: Minimum 32 in.—maximum 36 in.

   B. Drum diameter: Minimum 22 in. —maximum 24-in.

   C. Bung offset from chine: 5/8-in. either side of a selected average value.

The machine designed to these limits will, then, accommodate practically all existing drums, and will definitely accommodate all *new* drums.**

2. The non-uniform weights of empty drums required some type of automatic tare-weighing device to be incorporated into the filling scale. Some early attempts to build this feature into a standard beam scale were unsuccessful. The problem was finally solved when a device was developed that could be added to any standard dial scale that would accomplish the automatic tare.

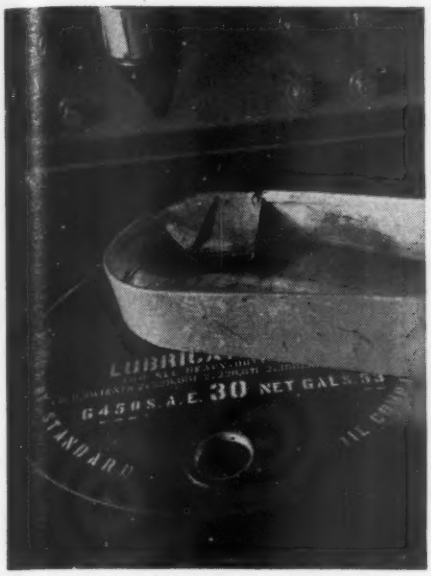
3. The foaming problem was solved by going to submerged filling. This is by no means a new idea but, combined with the feature of being fully automatic, represents quite a step forward. In submerged filling, care must be taken to avoid "weighing" the velocity of the flow. This was done by diverting the flow at the nozzle tip to approximately the horizontal direction, thus minimizing the condition. *When actual cut-off is made the flow is at the dribble rate, reducing the error to a negligible amount.*

An additional advantage of submerged filling is the minimizing of the static spark hazard when handling gasoline and other highly-volatile liquids.

Controls

Although the control circuit contains a few air and electrical components, it is predominantly hydraulic. When the

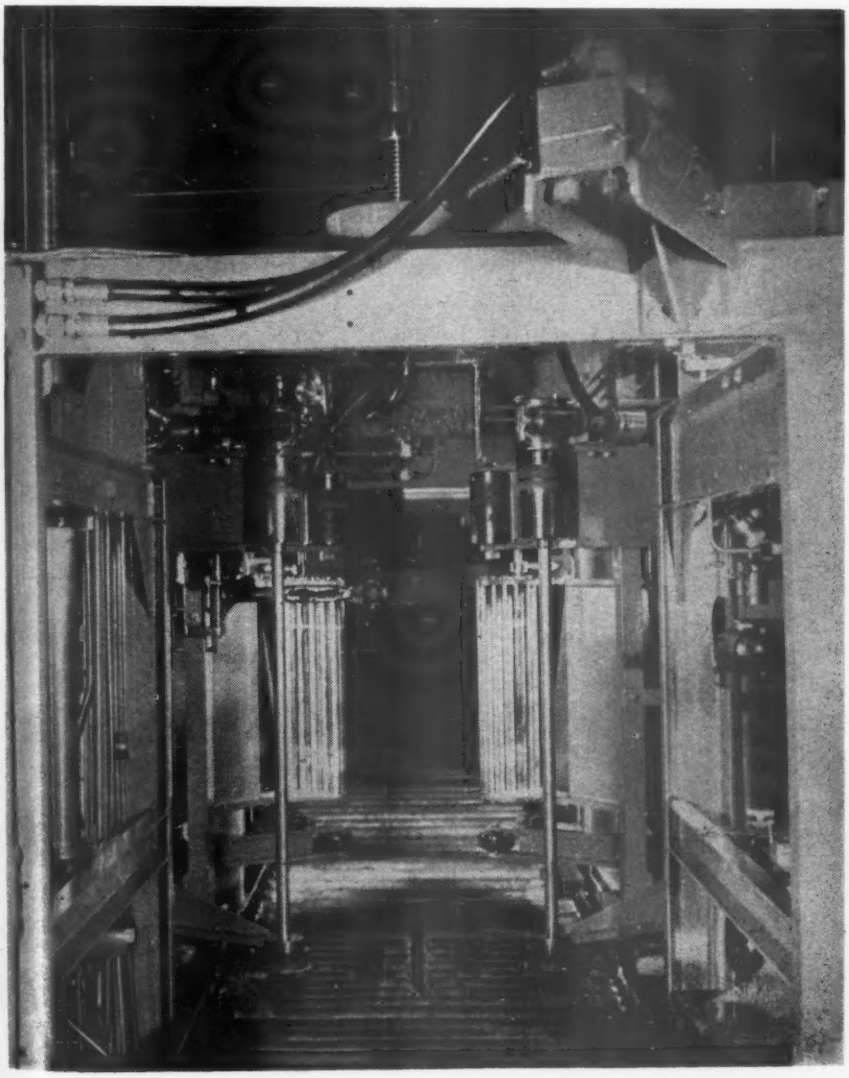
**One major exception to this statement. The machine as presently designed will not handle barrel-shaped drums, the so-called Bayonne barrel.



As filling lance withdraws, drip pan automatically swings under tip to keep drum tops clean. Dripped oil is returned to filling line. Completion of this cycle signals the unit to advance the next drum, which pushes the filled drum onto the take-off conveyor at the downstream end of the unit.

Lance tip with foot valve opened to show slots, which divert the high-pressure oil stream and prevent scale from "weighing" velocity of the oil. (Foot valve is normally closed when withdrawn from drum and was opened manually for this photo.)

"Drum's eye" view of unit from downstream end, showing admitting gate and rollers, which rotate drum at bung location station.



design of the machine had reached the stage where the various mechanical components and linkages had been completed, The Rucker Company of Oakland, California, was called in by Standard of California to engineer the control circuit for the machine.

A principle feature of the control circuit, aside from its automatic operation, is the system of "safe failing" interlocks to prevent oil spillage or machine damage in the event of interruptions in the power supply, the supply of empty drums, and other contingencies.

Principal safety interlocks are:

1. Interruption in supply of empty drums actuates an indicator valve in the circuit which allows the machine to proceed with the drum being filled on the scale, then wait until more empties arrive. The machine will proceed automatically when empties again reach it; no operator attention is required.

2. If the bung location cannot be "found" (due to an odd drum on the line with a bung situated beyond the limits of the design, or a drum bottom side up) the drum merely rotates in the bung location station until the operator notices and corrects the situation. As the carriage moving empties from the bung locating station to the filling station cannot move forward until the indicator valve shows that the bung has been located, the filling cycle will not proceed if the bung has not been located.

3. If an empty drum reaches the scale out of position so that the descending filling lance cannot go through the bung, the filling cycle is merely interrupted without damage or spilled oil until the operator notices and corrects the situation. The lance is not powered on the down stroke, and merely stops upon hitting the drum top; oil cannot flow until the lance is completely lowered to its filling position.

4. If the take-away or downstream conveyor is loaded with full drums, interlocks "hold" the machine until the conveyor is clear.

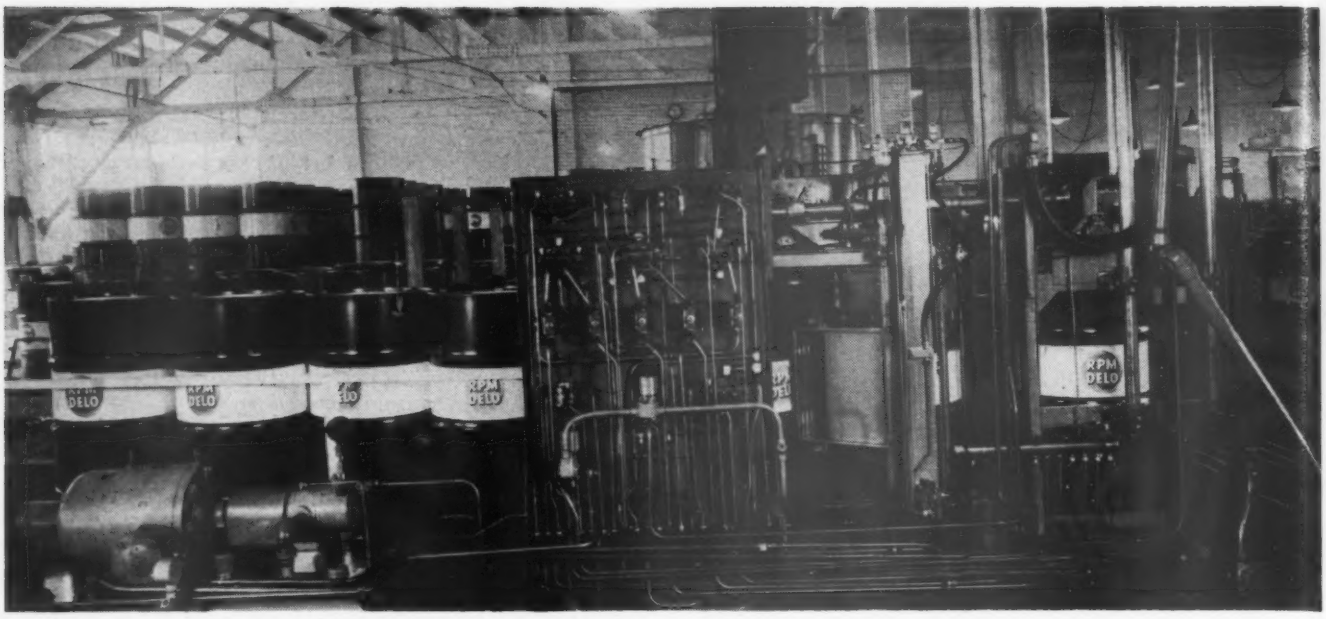
5. In the event of power failure, no oil can flow; the filling pump can only be operated when full pressure is maintained in the hydraulic control system.

Power Unit

The power unit for the hydraulic control system consists of a 10 hp 1200 rpm double shaft extension motor driving on one end a vane type pump delivering about 14 gal per minute at 500 psi. On the other shaft extension the motor drives a gear type pump delivering about 6.5 gal per minute at 300 psi. These units are mounted on a 150-gal tank.

Results

The first unit was built and set up as an experimental installation at Standard of California's Richmond refinery. Preliminary runs proved that many of the mechanical components of the machine should be re-designed, that the beam scale used in that installation would have to be replaced and that the control circuit could be somewhat simplified. After these items were accomplished the machine was installed in an



Rear view showing hydraulic power unit (left foreground) and back of control panel with hydraulic lines. Retracted filling lance is shown at extreme right.

operating conveyor line in the refinery where it has been operating for a little over a year.

Naturally, the machine is at its best on large orders of a single oil where it can work without interruption through one or more shifts until the order is completed. It is economically practical, however, to place smaller orders of possibly as low as 10-15 drums in the machine where, by careful scheduling, families of oils can be filled one after the other, minimizing the clean-up problem in changing oils. It has been learned on the existing installation, covering both large and small orders, that the machine is capable of filling an average of 1000 drums on an 8-hr shift. The machine is presently supervised by one operator who usually stands downstream of the filling scale, bunging up and cap-sealing the full drums. The machine then with one operator has a capacity of slightly more than three manual filling stations, while utilizing the floor space of little more than one. A further saving is realized through elimination of the human error in filling. It has been estimated that a manual filler over-fills by at least 2-2½ lb. The machine is capable of cut-off and handling methods which limit over-filling errors to the accuracy of the filling scale, in this case 1lb.

Low Downtime and Maintenance

Actual experience in operation at Richmond refinery demonstrated that downtime for mechanical reasons has been only about 1 per cent. The hydraulic power and control system has proved particularly trouble free. Standard Oil engineers have estimated maintenance costs for the entire machine to be in the neighborhood of $200 a year. This is based upon a maintenance expense of $400 a year including maintenance required by the feed pump and oil feed system and other pertinent facilities not basically a part of the filling machine itself.

Conclusion

Many allied improvements may be made to further enhance the value of this machine, such as multiple supply tanks manifolded to the filling pump near the machine where quick change-over techniques might be employed, increasing the machine's shift output. The present machine has been used exclusively on lubricating oils. It is readily adaptable to the filling of other liquids, however, such as gasolines, chemicals, liquid sugar, and possibly asphalts. While basic design and components of the machine are standard, it will be sold as a custom-designed unit to fit a particular installation.

In the case of filling hazardous chemicals or extremely hot liquids, the safety feature of being able to remove the operator from the immediate vicinity of the drum being filled should not be overlooked as additional justification for the use of the machine. * * *

Operator bungs up and cap-seals filled drums on down-stream conveyor.

Dr. V. A. Kalichevsky, consulting chemical engineer, Magnolia presided, February 13, at WPRA regional meet in Beaumont. Speakers include: W. W. McMullen, Magnolia, "Instructing the Worker on the Job"; K. E. Mills, Pan American Refining, "Pollution Creates an Attitude"; R. L. Nichols, Magnolia, "The Techniques of Training Foremen"; L. J. McGovern, Magnolia, "Applications and Practical Limitations of Statistical Quality Control Methods", Frank R. Shuman, Sun Oil, "Versatile Arosorb Process."

Personnel Management a Major Problem

Difficulties encountered in the selection and training of supervisory personnel are given more and more attention

ARCH L. FOSTER*

One of the most obvious signs of a relatively new trend in oil company management is the increased amount of attention being given by those who direct each company to the problems connected with personnel management, training, and selection. Although the more forward-looking oil companies have been progressing along this track for two decades or more, only in recent years, for the industry as a whole, has strong emphasis been placed on this human relations field.

Typical of the activities in the many subjects covered by the expression "Industrial Relations" are the four papers on as many different phases of it, and a discussion forum held by the Western Petroleum Refiners Association at its regional meeting in Beaumont, Texas, February 12-13, 1953. These four papers covered the most important phase of employee training. Forum discussion, as far as time permitted, ranged across the board of problems, but gave most attention to labor relations under the present-day conditions as typified by company-labor union contracts.

Similarly, the technical realm of petroleum refining was covered by papers dealing with purification of products, as segregation of aromatics by adsorptive methods, utilization of statistical methods in developing control systems for product manufacture, and methods of attacking corrosion and pollution problems.

Some of the ideas brought out show that employees wish to participate in activities, and that participation brings out cooperation among employees, as shown by F. E. Mathews of Standard Oil Company of Indiana. Employees may be trained best by several distinct steps that follow in sequence, as was outlined by R. L. Nichols of Magnolia's Beaumont staff. The employee's training takes place in four separate steps, preparation of the learner being the first. This step should be carried out in a conference or discussion group, Nichols stated. Supervisors or candidates for supervisory status are brought together under the direction of a qualified conference leader, who is a company employee, to *lead* but not to direct discussions, nor to give the answers. This conference leader should be neither too high nor too low in company rank. Main objective is to induce learners to teach themselves requirements for good supervisors by discussing and bringing out items required in such an employee. In one instance a group mentioned 42 items required of an understudy, that boil down to four, namely: (1) loyalty to company and to employees; (2) ability to "get along" with people; (3) ability to plan and coordinate work, and (4) initiative, to develop new jobs and methods.

The other three steps in training must be carried out individually, directed by the learner's immediate or near-immediate supervisor. The second step is demonstration of the operation under study, the instructor imparting to his student his own "trade secrets" in the matter, eliciting questions and discussion as to hows, whys, and whens. Third step is trying out the job in which the student takes the lead, and the instructor becomes observer and listener, allowing the student to utilize his own ideas even when they appear to be undesirable or inadvisable. The last step is the most difficult as it requires that the student "take over" and carry out the work along his own ideas with little direct supervision, and no advice until it is requested by the student. Throughout the training, example is considered to be the most effective aid.

Participation in activities by supervisors and employees has proved to be the best means of obtaining cooperation, in the opinion of F. E. Mathews, in surveying his own experience in "a small refinery" at Casper, Wyoming. Discussing a case where lost-time accidents gradually became more frequent and nothing appeared to halt the trend, the safety department was reorganized; supervisors and other employees were made a part of the foremen's meetings on safety practices, and employees were included in policy and inspection committees and given other special assignments that insured their getting into the act. The head of the safety department was busier than ever, aiding, advising, and helping supervisors get the new program started. Results observed were not immediate but over a period of years the number of accidents dropped markedly until of late a 423-day period elapsed without a single lost-time accident.

In another instance a series of conferences did not seem to be getting the job done in training supervisors. Conferences were of the lecture sort, with little or no participation or discussion-answer activities to get the supervisors into

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EXCLUSIVE

Other speakers at the Western Petroleum Refiners regional meeting were: C. E. Davis, PAD Deputy Administrator; F. E. Mathews, Standard Oil (Indiana), "Participation—Key to Supervisor Cooperation"; Dr. E. P. King, Pure Oil, Nederland, Texas, "Some Aspects of Lubricating Oil Manufacture"; W. P. Reymond, Esso Standard Oil, Baton Rouge, Louisiana, "Preparation for Retirement".

the meeting properly. The meetings were revamped into panel discussion assemblies and visual aids were introduced more often. One subject that created interest was a presentation by the assistant mechanical superintendent of the cost and values of equipment in the refinery. By this talk employees discovered the cost of many items they had not considered before, and learned something more about the need for economy in handling tools and equipment. An outstanding meeting was one in which the office manager showed what is done with data reported by supervisors in working out cost analyses, which was followed by a discussion led by superintendents on control of refinery operating costs, starting from the cost study of the previous meeting on analyses. Other studies include process fundamentals; coordination of operations by planning, to make possible the accomplishment of work in the most efficient and economical manner; experience in public speaking; applied psychology, and numerous others. Employees appear to like these efforts because they participate in them individually.

Even as retirement age approaches, the training of employees is not completed, W. P. Reymond, Esso Standard Oil Company, showed. Largely by means of a sound film Reymond presented the results of aiding old employees to work out activities for their retirement that resulted both in greater enjoyment of retirement but in many cases bring in additional income. Sometime prior to retirement dates—Esso requires men to retire at 65, women at 60—employees are informed at length regarding their status, the amount of pension they may expect and are encouraged to study further possible ways and means they may employ to earn money and be busy after they retire from their active jobs. Foremost is kept the idea that retirement is a change of occupation, not "the end of the road."

Following presentation of these papers a panel discussion was held on industrial relations, in which questions were directed largely to labor union activities, including recent developments in negotiatory regulations, and the trends in labor-management attitudes. It was brought out that companies are making progress in communications to employees. For example, after each negotiation meeting foremen and supervisors are informed regarding what transpired at the meeting. Care in maintaining communications is leading employees to consider the company to be the best information source. "Contributory agreements," for pensions, etc., in which the labor employee contributes part of the money for the purpose, are not to be signed by labor hereafter. CIO head Reuther is said to have decreed, the company to be called to contribute everything.

The Panel included R. B. McHenry, Gulf Oil Corporation; K. R. Dailey, Humble Oil and Refining Company; H. C. Reiniger, Pan-American Refining, and Joe Boston, Atlantic Refining.

Aromatics Recovery Increasing

A large number of combinations of operating conditions may be employed in concentrating aromatics by means of silica gel in the Arosorb process, according to Frank R. Shuman, Sun Oil Company spokesman. The adsorbent, silica gel, SiO_2, weighs 48 lb per cubic foot, is 16-to-200 mesh as usually employed, and packs rather firmly. Feed must be dehydrated to at least 25 parts per million to give satisfactory service. Gel can be regenerated by heat, in a manner similar to the methods used to regenerate alumina in a gas-drying setup. Polar adsorbents, such as alcohol, etc., drive most any product off the gel. In practice this process passes the aromatics-containing liquid through the gel bed, displacing the non-aromatic liquid thereon, after which a stream of paraffinic or other liquid is pumped through to push off the aromatics segregated and concentrated further in conventional fractionation equipment. Among the aromatics the isomeric xylenes are growing in interest in industry.

Handling of a crude, to be used as a source of lubricating fractions, in its processing prior to reaching the lube plant is extremely important, says E. P. King, technical director of heavy oil for Pure Oil Company at Nederland. Summarizing the operations in that new refining plant, King pointed out that they employ a two-stage, atmospheric and vacuum distillation. Vacuum bottoms are propane deasphalted, then blended with the "neutral oil" overhead fraction and sent to the phenol extraction plant, followed by the dewaxing step, and lastly to clay filtration. Many tricks and methods are found to affect results seriously. For example, the asphalt extract bottoms was found to contain too much propane, which is admitted to the extraction tower some distance above the lowest tray. By respacing the several trays below the propane inlet from a 12 to 16-in. interval this condition was remedied effectively. Under questioning it came out that devices for indicating and/or controlling interface level have not been too successful. Clay percolation has been found superior to contact clay treating to obtain odorless products.

Use of statistical methods to control manufacturing operations has become widely applied in the refining industry since about 1942. Prior to that the use of the system was infrequent, says L. J. McGovern, engineer for Magnolia Petroleum Company and specialist in this field. Statistical methods are applicable especially to "repetitive" operations, and for the testing of "accuracy" determinations. Determination of the value of variants and an analysis of variants in a process or product will indicate whether or not some condition that is different has crept into the operation.

At no time in this century has the trend upward of pollution been checked in industrial operations, is the not bright picture painted by K. E. Mills, technical adviser, Pan-American Refining Corporation. No employee wants a new, nonproductive responsibility added to his duties, yet we cannot "play the ostrich" and hope for better conditions. In the early days of serious pollution, the 1920-30 period, in one case of 306 plants 65 per cent of the pollution was traced to the petroleum industry, a condition that is being improved but not yet licked.

The general function and operation of the Petroleum Administration for Defense was outlined to the meeting by C. E. Davis, PAD deputy administrator in an unscheduled talk to the meeting on the situation and prospects. In general his discussion was in a hopeful, optimistic tone, especially in its forward look.

The Mexican petroleum refining industry is going ahead gradually and under considerable handicap, according to an informative discussion of the results of a two-months' survey of that industry in 1952, by D. P. Thornton, Jr., southwestern editor for *Petroleum Processing*. In nine existing plants and three destined to be built in the near future, a total of 236,000 bbl per day design capacity is available, of which a nominal 30,000 bbl per day will comprise the three new plants. In 1951 this existing capacity was operated at only about three-fourths of design rate, while in 1952 it is estimated that operations averaged about 170,000 bbl per day, or about 82 per cent of capacity. The three planned plants are on the West Coast, and problems exist in getting crude to them, which will be done by pipe line across the Isthmus and up the coast via tanker. A total of 68,000 bbl per day capacity expansion is planned, including three catalytic cracking units, lube refining facilities, and other units. * * *

P. 223.6

QUANTITATIVE ISOLATION OF FATTY ACIDS IN PETROLEUM OILS

LESTER R. DICKSON* and RAYMOND R. JAY*

In order to identify the various animal or vegetable oils contained in certain classes of petroleum products it is necessary first to isolate them. The following method provides a means of isolating quantitatively these saponifiable fats and oils as their corresponding fatty acids. Rosin and some sulfonates if present are included in the separated acids. The method as outlined below gives the total fatty acids contained in petroleum oils whether present as free fatty acids or combined as the glycerides. The standard ASTM procedures for acid number[1] and saponification number[2] may be used to determine the proportions of free and combined fatty acids.

The separation of fatty acids from various mixtures of petroleum products often presents serious emulsion breaking problems. The techniques used in this method have been designed to eliminate most of these problems.

Apparatus

Erlenmeyer Flask — Pyrex 500-ml or 1000-ml with standard ground joint
Reflux condenser, with standard taper joint to fit flask above
Glass beads
Separatory funnels, 500 and 1000 ml
Beakers, assorted
Watch glasses
Funnel, 60 deg long stemmed for 9 or 11-cm paper
Filter paper, qualitative 9 or 11-cm
Steam bath
Assembly for providing a jet of filtered air
Drying oven set for 105 C
Hot plate

Chemical Reagents

Petroleum ether, approx. 40-60 C boiling range
Ethyl ether, USP X
Ethyl ether, absolute (anhydrous, C.P.)
Ethyl alcohol, 95 per cent
Alcohol, 50 per cent solution — Mix equal volumes of 95 per cent ethyl alcohol or specially denatured alcohol Formula 30 or 3A and distilled water
Isopropanol, 99 per cent C.P.
Benzene, C.P.
Potassium hydroxide, C.P.
Sodium sulfate, anhydrous, C.P.
Methyl orange indicator solution, 0.1 per cent
Hydrochloric acid, dilute (1:2)

Procedure

Sample Size. The size of sample taken for the analysis should be such as to give the desired yield of fatty acids. Usually 5 to 10 g of fatty acids are desired for the subsequent identifying tests that may be required.

Saponification. Accurately weigh the sample into a 500 or 1000 ml standard ground joint Erlenmeyer flask. Add 5 to 10 g of potassium hydroxide dissolved in about 50 ml of 95 per cent ethyl alcohol. In order to assure complete saponification of even the most difficult materials, it is advisable to obtain a one-phase system. This is done by adding approximately 100 ml each of isopropanol and benzene. If this does not result in a one-phase system, add more benzene or isopropanol, or both, as the individual case may require. Sometimes complete solution is obtained only upon warming the mixture. After obtaining a clear homogeneous solution, add a few glass beads, attach the reflux condenser and reflux gently for 4 to 8 hr, or preferably overnight. Such extended refluxing time may not be necessary for most samples, but for some types of materials it seems to be the safest procedure to assure complete saponification.

Separation of the Oil-Free Soap Solution. If a large volume of solvents has been used in the saponification, it is advisable to evaporate down the contents of the saponification flask on the steam bath until nearly all of the isopropanol has been driven off. After evaporation the material is transferred to a separatory funnel with the aid of hot 50 per cent alcohol solution and petroleum ether. Sufficient 50 per cent alcohol and petroleum ether are added to thin out the soap solution and unsaponifiable petroleum oils in order to facilitate easy separation of the two layers. Care should be taken to allow the hot mixture to cool somewhat before adding the petroleum ether.

If the volume of solvents from the saponification is not too large and it is desirable to save time, the above evaporation procedure may be omitted. In this case transfer to a separatory funnel and add a volume of water equal to the volume of isopropanol present so as to form a 50 per cent isopropanol solution. Further dilution of the alcoholic layer may then be made with 50 per cent ethyl alcohol solution. In either case the use of a 50 per cent alcohol-water solution facilitates the separation from the petroleum oils and other unsaponifiable materials.

Shake the mixture in the separatory funnel and allow to separate. Draw off the alcoholic soap solution into a second separatory funnel. If separation is slow or difficult to obtain, the addition of a little ethyl ether may help. Use of too much ethyl ether, however, causes more of the soap to dissolve in the ether layer, thus necessitating a greater number of alcohol-water washes to remove it.

Wash the ether layer with 50 per cent alcohol until free of soap (colorless alcohol layer) and add the washings to the original alcoholic soap layer. If separation of the last few washes becomes difficult it may be helpful to add a little potassium hydroxide to the 50 per cent alcohol wash solution. The ether layer may now be discarded.

Wash the combined alcoholic solution and washings with petroleum ether until a practically colorless petroleum ether wash is obtained. Save and combine all of the petroleum ether washes. In case the petroleum ether does not "break" on standing, use a mixture of about 40 per cent ethyl ether to 60 per cent petroleum ether for the first few washes and then follow with one wash of pure petroleum ether. This last petroleum ether wash should come out practically colorless. The ethyl ether washes seldom come out colorless because apparently some of the soap is dissolved in the ethyl ether. This soap, however, will be recovered by washing these ether extracts with 50 per cent alcohol.

Wash the combined ether extracts with 50 per cent alcohol until the soap is removed (colorless). This ordinarily requires only two or three washes. A little KOH may be added to the alcoholic wash solution if separation is difficult. Add the combined alcoholic washes to the original alcoholic soap solution, and transfer to a beaker.

Precipitation of the "Separated Acids". Evaporate the alcoholic soap solution on the steam bath until all of the alcohol is removed. This usually is a time consuming operation and is perhaps best done on the steam bath overnight. Use of an air jet will hasten the evaporation and prevent foaming in the beginning when the residual ethers are being driven off. The evaporation usually goes almost to dryness before all odor of alcohol is gone.

Take up the alcohol-free soap in hot distilled water, keeping the volume as low as possible without producing a viscous solution. Add dilute (1:2) hydrochloric acid slowly with stirring until definitely acid. Cover the beaker with a watch glass and place on the steam bath until the fatty acids form a clear layer on the top and the lower water layer becomes clear or nearly so. Allow to cool to room temperature.

Isolation of the Fatty Acids. Transfer the water layer into a separatory funnel, leaving the layer of fatty acids in the beaker. Wash the water layer two or three times with *absolute* ethyl ether and discard the water layer. Add the fatty acids to the ether in the funnel and rinse out the beaker with small portions of absolute ether.

Wash the ether solution containing the dissolved fatty acids with a 10 per cent solution of potassium chloride in water until the washings are neutral to methyl orange indicator. Usually good separa-

*Sinclair Research Laboratories, Inc.

1. ASTM Standards on Petroleum Products and Lubricants, ASTM Designation D 974-51T.
2. ASTM Standards on Petroleum Products and Lubricants, ASTM Designation D 94-48T.

tions are obtained and only three or four washes are needed. Save the salt washes and wash once with absolute ether; then discard the salt washes. Now wash this last ether wash with small portions of the 10 per cent potassium chloride solution until free from acid. Discard these last salt washes but add the ether to the rest of the ether solution containing the separated fatty acids.

Dry the ether solution with small bits of torn filter paper, dry filter paper pulp, or anhydrous sodium sulfate. (The anhydrous sodium sulfate is a good drier but care must be taken to prevent traces of it from contaminating the fatty acids in case sulfur is to be determined on them.) Filter the dried ether solution through a coarse paper if filter paper or pulp was used for drying. Use a finer paper if sodium sulfate was used for drying. In either case, collect the filtrate in a tared beaker, evaporate off the ether on the steam bath using an air jet to prevent foaming and to hasten evaporation, and finally dry in an oven at 105 C for about an hour. Weigh the cooled beaker. The gain in weight represents the separated fatty acids.

Calculations

$$\text{Fatty acids, \%} = \frac{\text{grams fatty acids}}{\text{grams sample}} \times 100$$

Discussion

The procedure given is capable of yielding satisfactory results on a wide variety of samples. The use of absolute ether where prescribed in the procedure has been found necessary in order to obtain a product free of esters.

The fatty acids obtained are generally dark colored. They may be purified by means of a petroleum ether separation. Dissolve the fatty acids in petroleum ether, filter off the petroleum ether insolubles and evaporate off the petroleum ether in the filtrate to obtain the purified fatty acids. The yield of purified material is usually only a little less than the original and usually has a better color and appearance.

The fatty acids isolated by the above procedure may be identified in most cases by submitting them for a series of appropriate physical and chemical tests.

P. 265.

DETERMINATION OF ASPHALT CONTENT OF A LUBE CRUDE OIL RESIDUUM

F. J. HIGGINS*

THIS method has been developed and successfully used by Continental Oil Company for the determination of the asphalt content of lube crude oil residua. It produces a constant asphalt figure, based on the crude, when the determination is made on any length of lube residuum. The asphalt is determined from the color of three or four naphtha solutions of a lube residuum, which have been contacted with different quantities of Filtrol contact clay and the colors of which fall within a prescribed color range. This is an empirical procedure which depends upon the fact that contact clay will deasphalt a crude oil residuum by adsorption, with subsequent decrease in naphtha solution color in proportion to the asphalt adsorbed.

The method was originally based on the observation that, for the several residua first investigated, a point was reached where additional clay added to a naphtha solution of a residuum affected the viscosity of the remaining oil relatively little. Colors of the oil-naphtha solutions were observed at this point of small viscosity change, and a color range was chosen which indicated this condition. The colors were measured with a Klett colorimeter using a number 54 green filter, standard Klett test tube, and naphtha for zeroing the instrument. The color range where little change in the physical properties of the deasphalted oil occurs is 120-150 Klett color. Material removed versus color of the oil solution was plotted. From this plot, the material removed at a Klett color of 135 was considered to be asphalt.

The specially prepared scale for plotting the data is printed on 8½ in. by 11-in. paper and has a linear scale along the 8½ in. side for plotting color and a restricted range of normal probability scale along the 11-in. side for plotting per cent asphalt. Ranges are 0.5 per cent to 10 per cent, 1.5 per cent to 15 per cent, 6 per cent to 30 per cent, and 15 per cent to 50 per cent.

Specially designed hot plate for naphtha evaporation.

The quantity of material removed is determined by evaporation of an aliquot of the clay deasphalted naphtha-oil solution to determine the per cent of oil. The difference between the original sample and its oil content is the material removed by the clay.

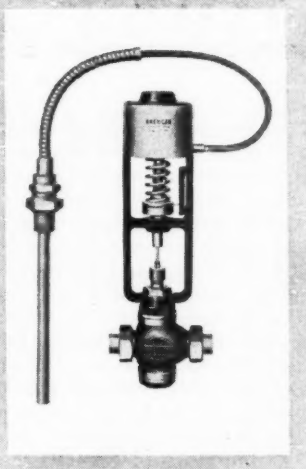
This method has been used by nontechnical personnel, having a high school education or equivalent, for the last seven years for routine crude oil evaluations. It has been very successful. The total elapsed time required for one determination is about eight hours. The person making the determination has some of this time free for performing other duties.

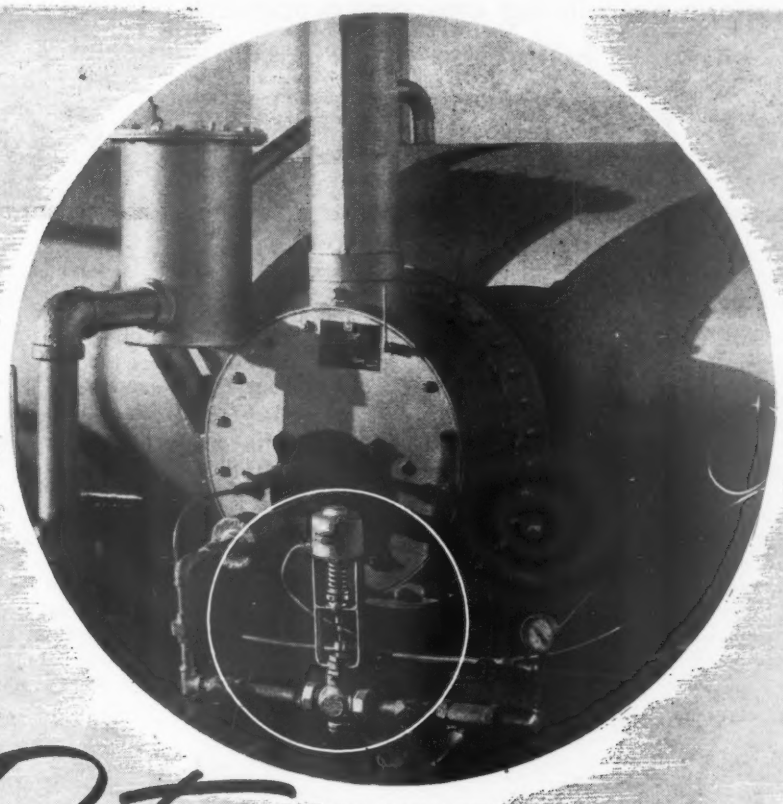
Procedure

Weigh a 25-g sample of lube residuum into each of five weighed 1-liter Erlenmeyer flasks and warm in an oven at about 200 F. Add 375 ml of ASTM precipitation naphtha to the first flask and cool the solution to 95 ±2 F. Contact this solution with well-mixed Filtrol contact clay in small weighed increments agitating for one to two minutes after each addition of clay until a color break occurs. (The quantity of clay required varies from less than 100 per cent up to 1000 per cent of the 25-g sample for high asphalt residua. If it is observed that a large quantity of clay will be necessary to reach a color break, increase the size of the incremental clay additions.) Filter a portion of the solution and determine its Klett color using a Klett test tube, Klett No. 54 green filter, and ASTM precipitation naphtha for zeroing the instrument. From this quantity of clay relationship to color, select four different quantities of clay for the remaining four flasks, which will produce Klett colors differing approximately equally from each other and falling within the range of 70 to 250. Add one of the four predetermined weighed amounts of clay, respectively, to each of the remaining four samples in one addition. Place the flasks in a shaking machine for one-half hour. A vented neoprene stopper in each flask prevents loss of material by splashing. Allow the samples to settle for 15 min after shaking, then weigh. Decant approximately 100 ml of each solution into separate centrifuge tubes and centrifuge for 5 min at 1500 rpm. Determine Klett colors of each solution after centrifuging. Pour approximately 75 ml of the centrifuged solutions into weighed 250-ml Erlenmeyer flasks. Determine the weight of each aliquot and place the flasks on a 220 ±10 F hot plate. Evaporate the naphtha by pulling air with a vacuum through the flasks at a rate of 5 ±1 liters per minute. Continue the evaporation for hourly intervals until constant weights (within 10 mg) are reached.

The accompanying photograph illustrates well the specially designed hot plate that is used for the naphtha evaporations. The flask adapters fit conveniently into the vacuum connections attached to the back of the plate. Of course, any temperature-controlled hot plate can be used.

*Associate research chemist, Continental Oil Company.





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TECHNICAL FORUM

Cleaning Asphalt-Handling Equipment

Q An asphalt-road oil unit is being revamped, and it is desirable to clean thoroughly the old equipment to be reused, including valves, fittings, heating and steaming coils, lines, tanks, and blowing vessels. What is the best procedure to follow in cleaning and reconditioning this equipment? Lines contain up to an inch or so of asphaltic material, but are open, so are valves. Tanks and blowers have an inch or so of tarry material in the bottoms, and considerable amounts clinging to the side walls.

—E. L. T.

A The cleaning of an asphalt road oil unit is a difficult task to perform, particularly where the deposit is of a solidified nature. This does not mean that the problem is an impossible one, but *it is always best to get the recommendations and methods for doing this work from the manufacturers of cleaning compounds.*

In our opinion the following steps will have to be considered:

1. The correct cleaning material will have to be selected and usually a combination must be employed.
2. It is advisable to circulate the solution through those vessels and lines with good velocity as the turbulence created removes the interfering deposit at a much faster rate than a still soak. A pump capable of discharging the solution at a rate of 200 gal per minute will greatly reduce time of cleaning operation.
   A still soak tank method will have to be employed to clean that equipment that does not lend itself to the circulating method.
3. Solution temperature is as important as the selection of the cleaning materials. The cleaning materials are designed to be used at a certain minimum temperature and if this is not reached it is quite probable that a failure will result.
4. Too much stress cannot be placed on the time of solution contact. Use as much time as possible.
5. A hot rinse at not less than 200 F usually removes the suspended deposit that has been softened by the solution.
6. It is important, and advisable, to consult with the representatives of cleaning material manufacturers as his opinion and sometimes chemical tests, will determine the proper material and method to use.

As a long range analysis of this problem we are of the opinion that the following cleaning materials and suggestions would greatly assist the person submitting this question:

a. Circulate hot water at 200 F through the equipment for 2 hours. Then drain to sewer.
b. Circulate a solution of Oakite Composition No. 19 at 8-12 oz per gallon. After complete circulation has been obtained, add 10 per cent of Oakite Composition No. 8 to the stock solution and bring temperature up to 190-200 F. Circulate for 16 hours. Then drain to sewer.
c. Duplicate Step A.

—V. E. Bowes.

Separation of Naphthenic Acids

Q Please give a satisfactory system for the separation of naphthenic acids from a middle or heavy petroleum fraction, including apparatus, reagents, and routine of attack on the problem. How may a mixture of these acids, so separated, be purified? Will appreciate a few literature references on the problem of isolating the more common individual acids. — M. C. F.

A Fundamentally the separation of naphthenic acids from middle or heavy fractions of petroleum involves neutralization of the acids by dilute sodium hydroxide, separation of the resulting water layer containing the sodium salts from the hydrocarbon layer, liberation of the acids from the sodium salts by addition of sulfuric acid, and final separation of the layer of liberated acids from the water.

Actually any acid obtained would be so badly contaminated by phenols, hydrocarbons, sulfuric acid, and other inorganic compounds dissolved or emulsified during the operations listed that the product could probably not be sold.

To obtain a salable product a batch process is usually used. This permits gentle agitation to get complete reaction without excessive emulsification, use of a settling period that yields clearly separated layers, and use of slightly less than enough 5-10 per cent base to neutralize all of the acidity so as to reduce the concentration of phenols in the acids. To cut down the settling time required the tank may be heated to 60-80 C but in the case of heavy fractions from some crudes emulsions are so troublesome that alcoholic sodium hydroxide solutions must be used thus increasing the cost so much that commercial production of acids is not feasible.

Emulsions again occur when the acids are liberated from the sodium salts by fairly concentrated sulfuric acid, but this results mainly in lower yield rather than in impure acids. Air blowing to be followed by water washing to remove sulfuric acid may clarify the acids.

In spite of these precautions the naphthenic acid concentration of commercial acids ranges from 95 to 65 per cent, the impurities consisting mainly of phenols and hydrocarbons dissolved or emulsified in the acids. Dark color may be partly removed by treatment with clay.

If further refining is needed, this is usually carried out either by treatment with a small amount of concentrated sulfuric acid or by distillation. Neither of these processes removes hydrocarbons but the acid treatment removes nearly all phenols, sulfur compounds, and nitrogen compounds that may have been present.

Distillation usually yields a lighter colored product and, since fractions are collected, a narrower boiling mixture but distillation has to be carried out in vacuum thus increasing costs materially.

If individual acids are to be isolated, much additional refining and fractionation is required. Usually the steps involved are conversion to sodium salts in alcoholic solution and washing of this solution with low boiling hydrocarbon to remove non-acidic impurities, liberation of the purified acids, preliminary fractionation in vacuum, conversion to the methyl esters, careful fractionation of the esters, also in vacuum, separation of the individual ester fractions or the acids derived from them by some different separation process such as countercurrent extraction or chromatographic separation and final conversion to a solid derivative or salt, which may perhaps be purified and the acid identified.

Actually no naphthenic acid with more than ten carbon atoms has been identified and the procedures listed above are probably the *minimum* number of separations required. The attached references include some of the many attempts, some partially successful, that have been made to identify naphthenic acids from petroleum fractions.

H. L. Lochte.

References

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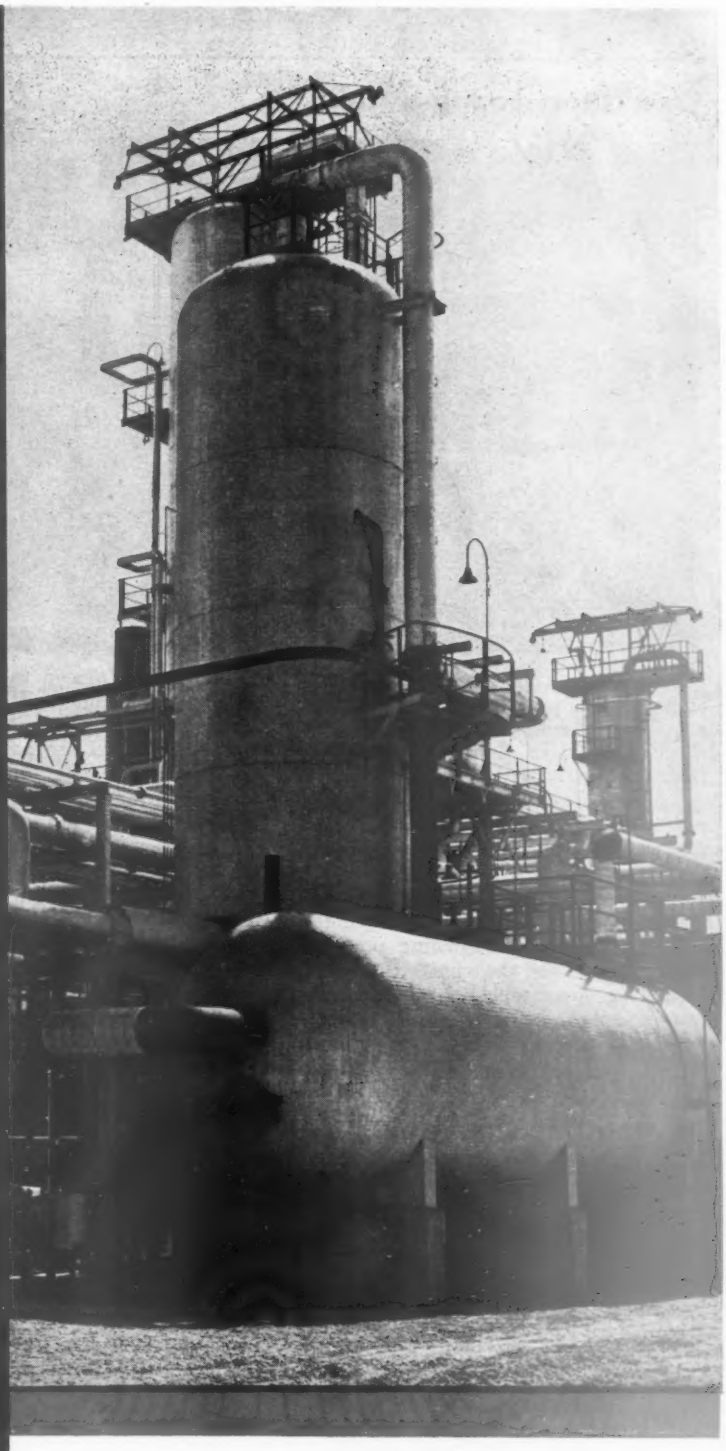
WHEN YOU NEED *Desalting*

BE SURE YOU GET SERVICE

Desalting, like any other refining process, should be designed, supervised and serviced by specialized experts. Many years of chemical desalting experience have convinced the Tretolite Company desalting engineers that complete service is necessary if efficient desalting is to be attained. Since the Tretolite Company pioneered chemical desalting, and since Tretolite currently is being used to desalt over a million and a half barrels of crude per day, we believe that these conclusions have a factual foundation.

The attainment of efficiency in chemical desalting just begins with the preliminary tests, specification and sale of the treating chemical. The treating plant must be designed to give the most efficient flow, proper heating, correct contacting and necessary residence time. All these are factors of design — important factors with which Tretolite desalting engineers are fully conversant.

At Tretolite, we believe that we can *sell* you the best desalting chemicals available; we will *give* you the best service.



Tretolite Desalting Service provides:

1. **Preliminary performance-prediction tests**
2. **Plant design assistance, drawings and consultation**
3. **Construction advice and supervision**
4. **Technical assistance for the "start-up"**
5. **Instruction of refinery personnel**
6. **Continuing service and periodic inspections**

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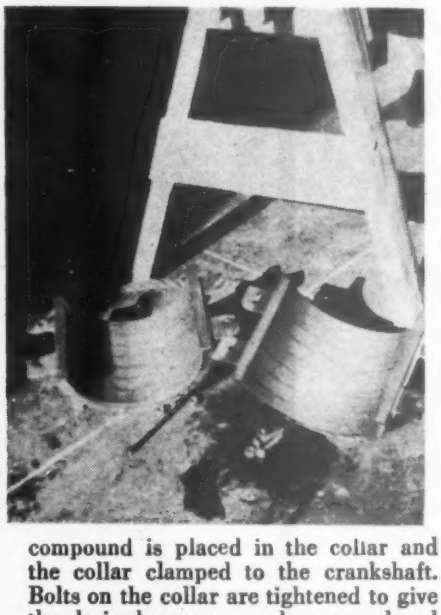
Chemicals and Services for the Petroleum Industry

SAINT LOUIS 19, MISSOURI • LOS ANGELES 22, CALIFORNIA

DESALTING • DEHYDRATING • CORROSION INHIBITING • SCALE PREVENTING • WATER DE-OILING • PARAFFIN REMOVING

Crankshaft Lapping Collar[1]

Purpose: For grinding out ridges in engine crankshaft.



Description: The crankshaft lapping collar, which is shown above, was improvised for grinding out ridges on a Worthington DDG-8 crankshaft. These ridges were too hard to be filed off. The collar was machined from cast iron to exactly the size of the piston rod bearing. Spiral grooves were turned in opposite directions from each end inside the collar. Bolts fastened through lips running lengthwise along each side of the collar are used for adjusting pressure of collar against the shaft. Ropes attached to opposite sides of the collar complete the assembly.

To put this device into use, lapping compound is placed in the collar and the collar clamped to the crankshaft. Bolts on the collar are tightened to give the desired pressure and a man placed on each rope. The collar is then seesawed back and forth for about ten minutes. The engine is then jacked over one-eighth revolution and the grinding procedure repeated. The spiral grooves tend to work the lapping compound back and forth in the collar without allowing it to work out either end. As the crankshaft is ground down, bolts are periodically tightened on the collar. Lapping compound is cleaned out and the crankshaft checked with micrometer approximately every thirty minutes.

[1]NGAA—Permian Basin regional meeting.

Computing Gas Volumes[2]

RAY E. SCURLOCK[3]

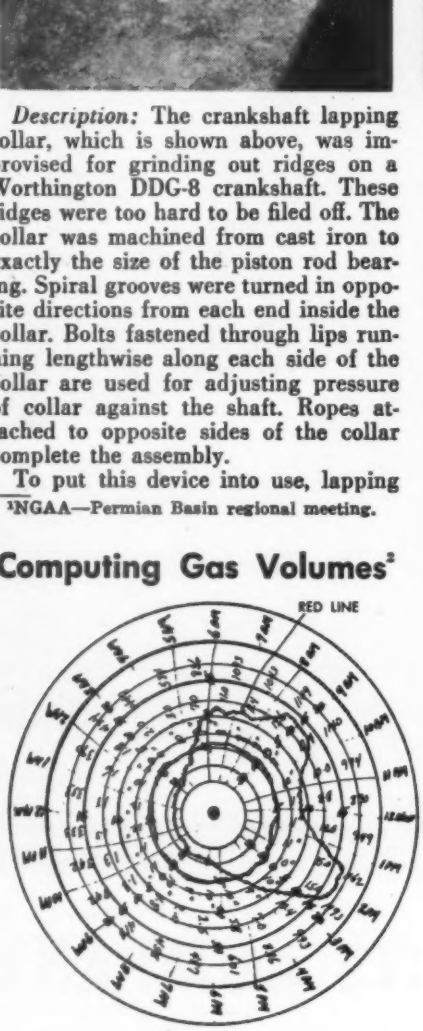


FIG. 1

Figures	72
Extensions added	24
Total figures	96

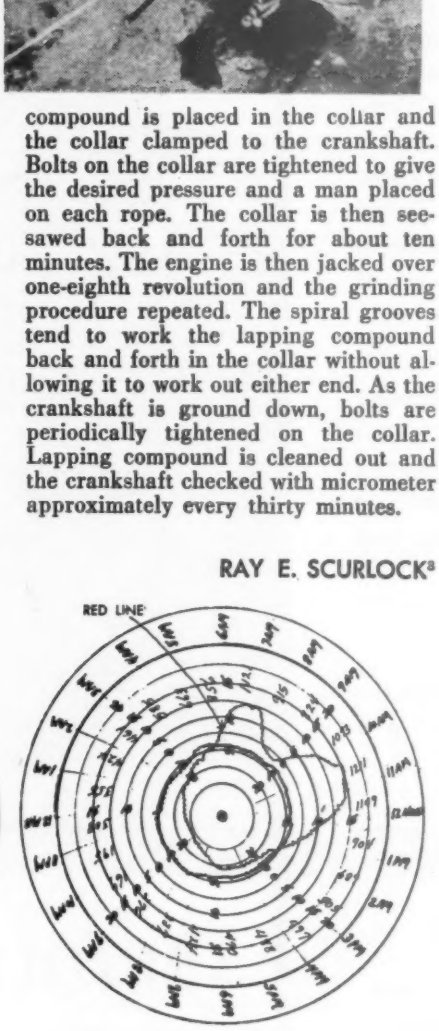


FIG. 2

Figures	24
Extensions added	24
Total figures	48

Purpose: To save time computing daily plant master meter charts.

One of the first things that the superintendent of natural gasoline plants would like to know each morning is how much gas was processed during the last 24 hr, the production, yield, and the rate of gas to the plant each hour. Naturally the plant report will have to be figured and the charts computed in order to furnish him with these figures. With these figures, he can note any irregularities, and have them corrected at once. The yield, gas and the rate of flow to the plant cannot be furnished until the charts have been computed.

Referring to Fig. 1, this chart is read the usual way by reading the static and the differential. By using these two figures and the pressure extension book, the extension is located. The extensions are added and the total is multiplied by the coefficient for that particular chart to arrive at the gas volume. This method was used and for computing 13 plant master meter charts, the average time was 65 min, using a total of 1248 figures.

Referring to Fig. 2, the chart was placed by the pressure extension book, and by reading the static and the differential, then quickly glancing at the pressure extension book, the extension was written down on the chart. The same 13 plant master meter charts were computed by this method on an average of 35 min, using a total of 624 figures. The method used in computing the charts on Fig. 2 has been checked with an integrator, and the gas volume has been very close.

[2]Class B third prize winner at NGAA.
[3]Chief clerk, Warren Petroleum Corporation, Gladewater, Texas.

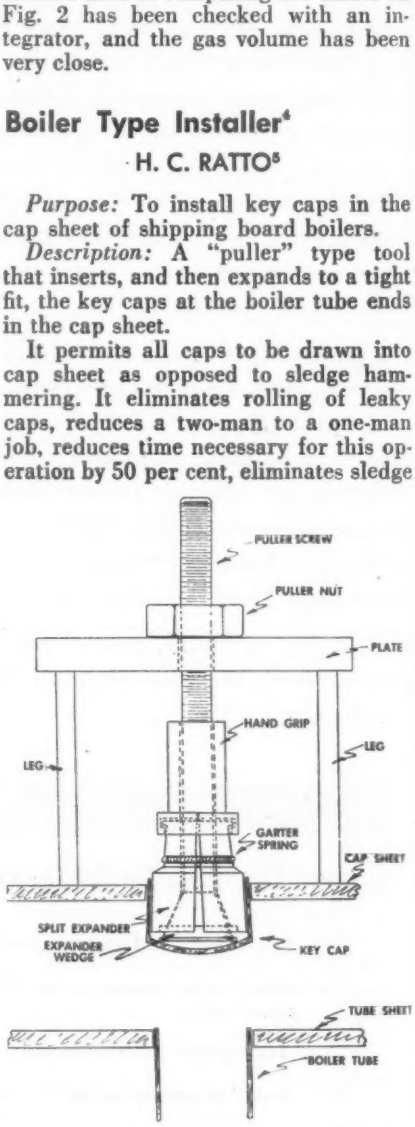
Boiler Type Installer[4]

H. C. RATTO[5]

Purpose: To install key caps in the cap sheet of shipping board boilers.

Description: A "puller" type tool that inserts, and then expands to a tight fit, the key caps at the boiler tube ends in the cap sheet.

It permits all caps to be drawn into cap sheet as opposed to sledge hammering. It eliminates rolling of leaky caps, reduces a two-man to a one-man job, reduces time necessary for this operation by 50 per cent, eliminates sledge hammer damage to caps, straightens bent caps, and eliminates the safety hazard of manipulating a sledge hammer in a semi-awkward position.



The tool has proved itself in use.

[4]Class A, third prize at NGAA—Permian Basin regional meeting.
[5]Roustabout, Phillips, Odessa, Texas.

Work Proceeds on Standard North Dakota Refinery

Standard Oil Company's Mandan, North Dakota, refinery payroll will be about a million dollars a year, T. E. Stockdale, manager, predicted here recently.

While October 15, 1954, is specified as completion date for all construction work, operation of the refinery may get under way earlier, he said.

Speaking on "Mandan's New Enterprise" at the annual meeting of the Mandan Chamber of Commerce, the Standard executive also announced the construction schedule of the projected 30,000-bbl a day refinery:

1. Ground breaking and grading of site—April, 1953, or earlier if weather permits.
2. Pouring concrete foundations for storage tanks—early summer, 1953.
3. Completion of warehouse and shop —before winter, 1953.
4. Start of delivery of special equipment—fabricated meantime at various points throughout the U. S.—winter, 1953.
5. Specified completion date for all construction, and "on stream" operation —October 15, 1954.

Additive Plant Announced

The Lubrizol Corporation has acquired a site of 17 acres in the vicinity of Niagara Falls, Ontario, and will build an additive plant representing an initial investment of around $400,000, President Kelvin Smith announced. The new plant will produce a full line of motor oil and gear lubricant additives for Canadian refiners. It will be the first plant to manufacture these products in Canada.

The Canadian company will be known as Lubrizol of Canada, Ltd., and will have the same staff of officials as the parent company. These are Kent H. Smith, chairman of the board; Kelvin Smith, president; F. Alex Nason, senior vice president; Thomas L. Holland, vice president sales; Arthur O. Willey, vice president—engineering; Clyde H. Britten, vice president—manufacturing; David K. Ford, secretary, and Russell J. Ferree, treasurer.

Radiation Effect on Lubricants Tested

The West's first high-intensity industrial source of gamma radiation, one of the kinds of rays given off by an atomic "pile," is now being used by California Research Corporation to test the effects of irradiation on lubricants and other materials likely to be exposed to radioactivity in an atomic engine.

Cal Research, subsidiary of the Standard Oil Company of California, is carrying on the experiments at its laboratories in Richmond under a contract with the Atomic Energy Commission.

The radiation source has been supplied to Cal Research by the AEC for the duration of the project. Previously, materials employed in industrial atomic research had to be sent to one of the AEC's own installations for irradiation.

Chemical Group Forms Dallas, Texas, Club

The Dallas Chemical Engineers Club has been organized by some 60 of the 130 chemical engineers residing in the Dallas, Texas, area, Harold A. Blum, secretary-treasurer of the club has announced. The club will have at least five meetings per year, at which the latest developments in chemical engineering fields will be discussed, and the subject matter will be general and not confined to one or a few industries, the secretary-treasurer stated. Chairman of the club is R. A. Graff, of Graff Engineering Company, of Dallas.

Other officers are: Vice chairman, Robert Purvin, and executive committee, C. F. Tears, Ovid Baker, Sidney Lee, and H. A. Koch, Jr.

Pure to Enlarge Plant

Pure Oil Company of Chicago will construct additional boiler house facilities and auxiliaries at its Toledo, Ohio, refinery.

The work, being undertaken by Catalytic Construction Company, is in connection with new catalytic cracking facilities and new copper oxide naptha treating units now being installed.

The various new units now under construction are the nucleus of a major expansion program at Toledo refinery.

Gamma radiation unit now being used by California Research Corporation, subsidiary of Standard Oil Company of California, to test the effects of irradiation on lubricants and other materials likely to be exposed to radioactivity in an atomic engine.

The radioactive "source," a fourteen inch section of two-inch cobalt tubing, is housed vertically in the drum-shaped lead shield at the center of the photo. Shield weighs two tons. Operator removes long "plug" from the shield by remote control mechanism, preparatory to inserting test material to be exposed to radiation. Door at right is open for photography; it normally remains closed.

United Refining to Build Cat-Forming Plant

United Refining Company has announced plans to build a $1,000,000 cat-forming plant to produce high octane gasoline in Warren, Pennsylvania.

The new plant, which will use Atlantic Refining Company's catalytic reforming process will have a capacity of 2500 bbl per day of blending stock.

United has specialized in the production of high quality lubricating oils for more than 50 years. With the new cat-former the company plans to raise its gasoline production to 3500 bbl per day —double its present output.

Construction and design of this plant is being handled by the Blaw-Knox Company and Blaw-Knox Chemical Plants Division which expects to have the new facilities in operation during 1953.

Tax Write-offs Awarded

Special tax write-offs have been granted to six companies for refinery expansions. National Production Authority awarded rapid write-offs permitting the companies to depreciate their properties for tax purposes in five years.

Companies include: Phillips Petroleum Company, Upton County, Texas, refining facilities, 65 per cent of $4,845,000; Panhandle Oil Corporation, Wichita Falls, 40 per cent of a $29,050 investment; Ada Oil Company, $91,450, 60 per cent; Col-Tex Refining Company, Colorado City, one certificate for 65 per cent of $903,525 expansion and one certificate for 50 per cent of a $30,000 expansion; Phillips Petroleum, Dumas, 65 per cent for $223,000, and in Oklahoma, Mid-Continent Petroleum Corporation, $74,180, 40 per cent.

Chemical Unit Begun

Jefferson Chemical Company, Inc., has announced the start-up of a new general purpose chemical process unit at its Port Neches, Texas, plant. Nonyl phenol is the initial product, and commercial quantities are already available. Other related chemicals may be produced in the unit with but minor field design changes, as market conditions may require.

Nonyl phenol finds increasing use as an intermediate in the manufacture of non-ionic surface active agents, rubber chemicals, and lubricating oil additives, and as a starting material in the preparation of certain resins and plasticizers.

Processing Plant Planned

Tennessee Production Company will build a 100,000,000 cu ft-per-day natural gas processing plant to be situated in the Agua Dulce area, it was announced by O. L. Olsen.

The plant will recover approximately 70,000 gal of liquid hydrocarbons daily. Orders are being placed for materials and equipment and it is expected that construction will be completed and operations commenced during the fall of 1953.

The O. L. Olsen Company of Houston, Texas, has been awarded the contract.

News

API Compounds Available

New compounds available as American Petroleum Institute Standard samples of organic sulfur compounds as of October 1, 1952. These samples were purified by the American Petroleum Institute Research Project 48A at the U. S. Bureau of Mines, Laramie, Wyoming.

A list of organic sulfur compounds now available may be obtained on request to Carnegie Institute of Technology, Attention of Frederick D. Rossini, American Petroleum Institute Research Laboratory, Pittsburgh 13, Pennsylvania. Orders should be accompanied with full payment in advance, with check made out to the Carnegie Institute of Technology.

Each order should give the following information for each compound wanted: name of compound, number of the samples, size of unit, number of units, price per unit, total cost.

Sample number[1]	Compound		Amount of impurity	Vol. per unit[2]	Price per unit
	Formula	Name	mole per cent	ml (liq.)	dollars
16-5S	C_5H_6S	2-Methyl-thiophene	0.04±0.04	5	$50.00
17-5S	$C_5H_{10}S$	Thiacyclohexane (Pentamethylene sulfide)	0.06±0.06	5	50.00
18-5S	$C_4H_{10}S$	2-Thiapentane (Methyl n-propyl sulfide)	0.03±0.03	5	50.00
19-5S	$C_4H_{10}S$	2-Butanethiol (sec-Butyl mercaptan)	0.1 ±0.1	5	50.00
20-5S	$C_4H_{10}S$	3-Methyl-2-thiabutane (Methyl isopropyl sulfide)	0.01±0.01	5	50.00
1021-5S	C_5H_{10}	1, trans-2-dimethyl-cyclopropane	0.23±0.12	5	50.00
1022-5S	C_9H_{16}	trans-hexahydroindan (trans-hydrindan)	0.29±0.11	5	50.00
1023-5S	$C_{10}H_{22}$	3,3,5-Trimethyl-heptane	(0.20± 0.15)[3,4]	5	50.00
1024-5S	C_5H_{10}	1, cis-2-Dimethyl-cyclopropane	0.13±0.05	5	50.00
1025-5S	C_7H_{14}	2-Methyl-1-hexene	0.12±0.08	5	50.00
1026-5S	C_7H_{14}	2-Methyl-2-hexene	0.14±0.11	5	50.00

[1] The designation "-5S" following the sample number indicates a sample of 5 ml (liquid) sealed "in vacuum" in a special Pyrex glass ampoule with internal "break-off" tip.
[2] Tolerance approximately ±10 per cent.
[3] The purity has been evaluated from measurements of freezing points in accordance with the method and procedure of the American Petroleum Institute Research Project 6, as described in J. Research Natl. Bur. Standards 35, 355 (1945), and Anal. Chem. 20, 410 (1948), unless otherwise noted.
[4] Estimated by analogy with isomers subjected to similar purification.

Sinclair to Increase Wyoming Refinery Output

Sinclair Refining Company is proceeding with additions to the Sinclair, Wyoming refinery, which will permit complete processing of some 6000 bbl of additional crude per day. These additions consist of new equipment that will remove bottlenecks on the crude and vacuum stills, together with the addition of a new air blower to the fluid cracker which will increase its capacity from 9000 to 12,000 bbl per day. It is expected that the new facilities will be completed early in the summer of 1953.

The additional products made by these facilities will include motor and aviation gasoline and distillate fuels. These products will be available for shipment through the new Pioneer Pipe Line system to Salt Lake City and thence through the Salt Lake Pipe Line system into the Pacific Northwest which is an area where these products are now needed for military and industrial installations.

Turkey's First Refinery Set

A contract to build the Turkish nation's first major oil refinery and pipe line at a cost of approximately $8,000,000 has been awarded to The Ralph M. Parsons Company.

Construction will probably begin by mid-year, with completion of certain parts this year and final completion scheduled for late 1954.

It is planned that Turkish operators will be trained in the United States during the pre-construction period. The refinery will be operated under American superivsion during the first year of operation, but will gradually be turned over to an all-Turkish staff as personnel become trained.

This will be Turkey's first refinery. It will have a capacity of 6250 bbl a day, and construction will include 25 miles of pipe line from the newly developed fields.

The refinery will incorporate the latest type Socony-Vacuum thermofor catalytic cracking unit, and will manufacture motor gasoline, kerosine, diesel fuel, jet fuel, fuel oil and asphalt. The fuel oil will be used by the Turkish railroads, while the asphalt will go into the fast-expanding Turkish highway system. The refinery will be located at Batman, some 60 miles east of the ancient city of Diyarbakir, and close to the Raman and Garzan oil fields developed by Turks.

Freeport to Mine Fourth New Sulfur Deposit

Freeport Sulphur Company has announced plans for the development of a new sulfur mine—the company's fourth new sulfur project in two years—at a salt dome deposit in the Louisiana marshland. The dome, known as Chacahoula, is in Lafourche Parish 8 miles southwest of the town of Thibodaux and 60 miles west of New Orleans. Freeport has been conducting an extensive drilling program there since last April.

The area lies in the midst of dense cypress swamps, and the undertaking will involve unusual and costly engineering and construction difficulties, according to Langbourne M. Williams, Jr., president of the company. The size of the mining plant to be built will depend upon the results of further studies of these problems, he said.

IGT Fellowship Program

The Institute of Gas Technology, affiliated with Illinois Institute of Technology, announces the availability of 15 fellowships for 1953, leading to the degrees of master of science in mechanical engineering or chemical engineering, or master of gas technology and doctor of philosophy.

The master of science curricula are additions that will accelerate the fellowship program to enable the earning of a master's degree in about 15 months, instead of the two years still required for the master of gas technology.

Houston Refinery Men Hosts

D. A. Young, manager of Sinclair's refinery at Houston, Texas, was host to representatives from Sinclair's New York office, its East Chicago, Indiana, Marcus Hook, Pennsylvania, and Wellsville, New York, refineries for a three-day symposium recently.

Among the subjects discussed were problems in cost accounting, methods of blending and compounding petroleum products, storage of packaged products and equipment for handling packaged products within the refinery, and oil drum reconditioning costs.

Monsanto Given Patents

Two United States patents pertaining to synthetic organic chemical soil conditioners have been issued to Monsanto Chemical Company, vice president John L. Gillis, announced. The first of these, U. S. Patent No. 2,625,529, pertains to the use of a large and diversified class of synthetic organic polyelectrolytes as soil conditioners, including Monsanto's Krilium soil conditioners.

The other patent, U. S. No. 2,625,471, pertains to plant fertilizing compositions containing plant nutrients and certain synthetic organic polyelectrolytes.

Esso Standard to Build New Distillation Unit

Esso Standard Oil Company has announced plans for a 60,000 bbl-per-day crude distillation unit at its Bayway, (New Jersey) refinery.

This addition to Esso's production facilities will provide a major increase in the crude capacity of the Bayway refinery, largest on the East Coast.

The unit, itself, will be a three-stage plant similar in design to two now under construction by M. W. Kellogg Company for Esso at its Baton Rouge refinery. Engineering is currently underway with actual erection scheduled to start in early summer. Kellogg has been awarded contract for Esso's newest plant.

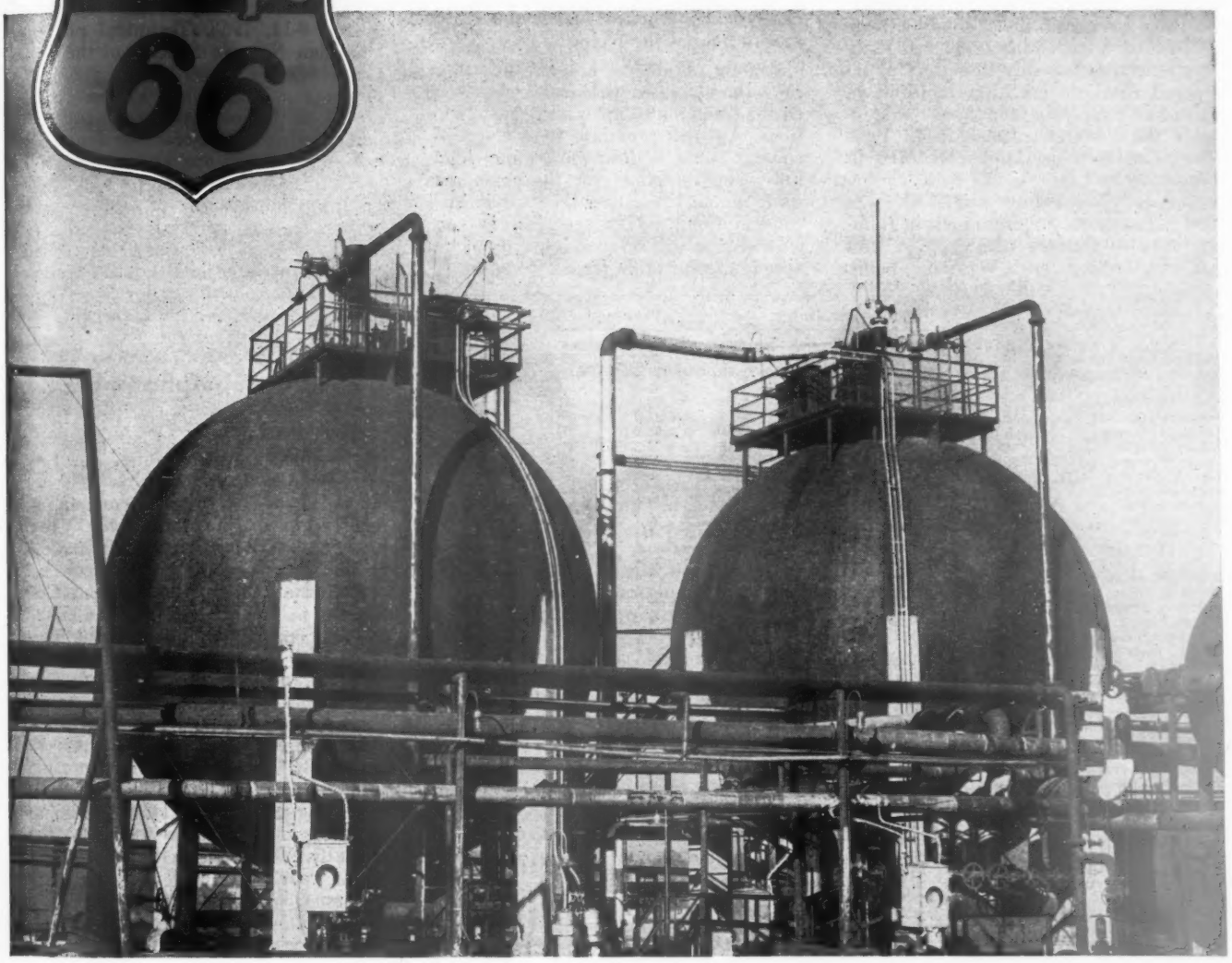
Communications Meet Set

A Symposium on Communications will be one of the outstanding features of a joint meeting in Toronto, April 27-29, of two leading chemical engineering groups. This joint meeting is sponsored by the Chemical Engineering Division of The Chemical Institute of Canada, and the American Institute of Chemical Engineers. It will be the first joint conference of these two groups, and conference officials expect about 700 executives and engineers to attend. Other items on the program will include a series of technical papers, and plant tours to Toronto, Hamilton, and Niagara Falls areas.

Among featured speakers at the meeting will be Robert H. Saunders, chairman of the Hydro Electric Power Commission of Ontario. Saunders' address will be a report on Hydro matters of concern to engineers and executives attending the conference and he will deal in particular with the St. Lawrence Waterway and Power Development.

Phillips 66

another leading refiner who desalts with PETRECO



Phillips Petroleum Company has earned a place of leadership in the oil industry by manufacturing and marketing products of the highest quality. To consistently produce excellent products, a refining organization must possess and utilize a high degree of technological know-how.

One phase of Phillips know-how is their insistence on the absolute minimum of residual salt in the crude charge. Like other leading refiners, Phillips knows that salt in the crude charge, even in nominal tolerances, is a certain trouble-maker. The fact that Phillips utilizes Petreco Electrospheres at Phillips, Texas, to hold the salt content of the crude charge to this refinery to their required low minimum is of considerable significance.

Like other leading refiners everywhere, Phillips not only produces the best products possible—they help to assure this excellence of product by utilizing Petreco Desalting, the desalting process with an established reputation and known standards of performance and service.

Complete information on Petreco Electric Desalting and other refinery processes is yours for the asking.

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FUEL STOCKS: DESAPONIFICATION

PR 52-4

Octane Increases Slight

Overall octane rating changes in the du Pont January, 1953, motor fuel survey were slight, a study of the figures discloses. For premium fuels with one exception the changes were fractional; El Paso premium fuels climbed from 78.7 Motor last October to 82.8 in January, reflecting possibly the effect of increased catalytic cracking facilities in refineries supplying that area. Analogously the research ratings in El Paso rose from 86.0 in October to 90.6 in January.

Generally speaking, less TEL was used in nearly all premium fuels in January than in October, the drop in lead consumption in Casper, Wyoming, being especially notable, from 2.03 cc last July, to 1.71 cc in October, and 1.34 cc in January. While operating (atmospheric) temperatures in that high mountain region explain some of this drop it is probable that increased output of catalytically cracked fuel is the major reason behind the change.

Among regular or housebrand motor fuels the increases were either non-existent or fractionally upward in most locations. As with premium fuels the TEL content trend is downward quite definitely, and doubtless for the same reasons. In many instances the drop in lead consumption, percentage-wise, is considerable as will be seen by study of the accompanying table from the report.

	Octane number, Jan.		Tel content	Octane number, Jan.		Tel content
Premium	Motor	Research	cc/gal	Motor	Research	cc/gal
Aberdeen, South Dakota	82.9	90.0	2.17	79.3	83.3	1.66
Amarillo, Texas	81.2	89.4	2.14	78.5	81.5	2.27
Atlanta, Georgia	82.4	92.5	1.98	80.5	85.3	2.12
Bakersfield, California	84.3	89.2	2.59	76.7	80.6	1.56
Baltimore, Maryland	82.7	92.4	1.98	81.1	86.8	2.03
Boston, Massachusetts	83.1	92.7	2.20	81.0	87.6	1.88
Calgary, Alberta	78.2	86.6	2.47	77.1	81.3	2.28
Casper, Wyoming	80.4	89.0	1.34	76.5	82.2	1.09
Charlotte, North Carolina	82.7	92.5	2.11	80.4	85.3	1.91
Chicago, Illinois	82.4	90.4	1.95	79.4	83.8	1.76
Cincinnati, Ohio	83.4	92.2	2.53	80.5	86.6	1.94
Cleveland, Ohio	83.5	92.8	2.52	80.7	87.4	1.58
Columbus, Ohio	83.4	92.0	2.16	81.4	87.6	1.81
Corpus Christi, Texas	85.2	91.9	2.28	82.3	84.6	2.32
Dallas — Fort Worth, Texas	83.4	92.4	2.09	79.8	84.5	2.30
Denver, Colorado	81.4	89.7	1.54	77.4	81.1	1.47
Detroit, Michigan	83.6	92.3	2.08	80.4	87.0	1.59
Edmonton, Alberta	80.6	87.1	1.72	77.1	82.5	1.15
El Paso, Texas	82.8	90.6	2.74	77.7	81.3	2.00
Great Falls — Billings, Montana	81.2	90.7	1.76	76.6	83.0	1.31
Houston, Texas	83.7	92.1	2.25	80.9	85.2	2.24
Indianapolis, Indiana	82.3	90.0	2.12	79.5	84.0	1.95
Jacksonville, Florida	82.4	92.3	2.06	80.8	85.8	2.07
Kansas City, Missouri	82.7	90.1	1.98	79.6	83.3	1.91
Little Rock, Arkansas	83.6	91.7	1.95	79.5	85.4	1.55
Los Angeles, California	81.8	90.8	2.08	77.2	82.8	1.67
Louisville, Kentucky	83.3	91.8	2.49	80.4	86.1	2.31
Memphis, Tennessee	83.1	91.6	2.46	79.8	85.4	1.92
Milwaukee, Wisconsin	83.0	91.4	2.12	78.6	83.9	1.58
Minneapolis, Minnesota	83.1	89.9	2.31	79.5	83.4	1.79
Montreal, Quebec	81.6	90.3	1.21	79.1	86.3	0.79
Nashville, Tennessee	83.1	91.8	2.23	79.8	85.2	2.13
New Orleans, Louisiana	83.8	91.6	2.30	79.4	85.7	1.85
New York, N. Y. (Metropolitan Area)	82.8	92.2	2.20	81.5	87.0	1.97
Omaha, Nebraska	82.8	89.6	2.18	79.0	82.7	1.40
Philadelphia, Pennsylvania	82.2	92.3	2.08	81.0	87.1	2.19
Pittsburgh, Pennsylvania	82.3	92.1	1.93	80.7	87.3	2.14
St. Louis, Missouri	82.5	90.1	1.93	79.4	83.9	1.74
Salt Lake City, Utah	81.3	87.9	1.05	75.1	79.7	0.43
San Francisco, California	82.0	91.4	1.99	76.8	82.4	1.50
Seattle, Washington	82.1	90.7	2.41	77.4	82.0	1.83
Shreveport, Louisiana	84.9	91.6	2.64	81.0	84.9	2.34
Spokane, Washington	81.3	90.1	1.82	77.8	82.9	1.46
Toronto, Ontario	81.6	90.3	1.85	79.7	86.4	1.86
Tulsa, Oklahoma	83.0	90.2	2.05	79.5	83.1	1.60
Vancouver, British Columbia	82.1	89.0	2.82	80.0	82.7	2.09
Wichita, Kansas	83.1	89.2	2.58	79.5	82.7	1.92
Winnipeg, Manitoba	80.9	88.8	1.41	79.1	84.7	1.14

Thermodynamics Report Out

Basic information on the thermodynamic properties of combustion gases is presented in Bureau of Mines technical report of investigations released by Secretary of the Interior Douglas McKay.

Thermodynamics is a branch of science dealing with the energy content of a substance and the energy changes that take place when the substance forms.

Report is the second of a series giving results of the study for particular fuel-oxidant systems. It evaluates the constant pressure flame temperatures of methane-air and propane-air flames at atmospheric pressure as functions of the mixture ratio and inlet temperature of the fuel-air stream. A free copy of Report of Investigations 4938, "The Thermodynamics of Combustion Gases; Temperatures of Methane-Air and Propane-Air Flames at Atmospheric Pressure," may be obtained from the Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh 13, Pennsylvania.

Alkylation Unit Added To Wyoming Refinery

Standard Oil Company announced plans for a new alkylation unit at its Casper, Wyoming, refinery. Design of the new 700 bbl a day unit is already in final stages.

Construction is expected to begin during the summer of 1953. Completion and initial operation are scheduled for May, 1954.

Other additional new construction will provide tankage and off-site facilities necessary to integrate the new alkylation unit with the existing refinery at Casper. This construction will proceed concurrently with Kellogg's construction of the new refinery unit. M. W. Kellogg is prime contractor for the unit.

AIChE Meeting This Month

Mineral engineering techniques for chemical engineers will be the main feature of the Biloxi, Mississippi, meeting of the American Institute of Chemical Engineers, at the Buena Vista Hotel, March 8-11, 1953. Technical program chairman Norman Spector of the Vitro Corporation of America has planned a program on mineral engineering techniques, with contributions from 31 experts, designed "for teaching the chemical engineer of operations that have heretofore been foreign to him." This program consists of an all day symposium on flotation and a day devoted to panel discussions on fine sizing, sizing devices, sink, and float separation methods and concentrating devices. A program is planned for the ladies.

Davison to Be Producer Of Triple Superphosphate

Early 1954 operation is expected of the $12,410,000 plant for production of triple superphosphate which The Davison Chemical Corporation is constructing at Bartow, Florida, the company announced. It will have an annual capacity of 200,000 tons of the agricultural chemical and according to a recent survey by the Florida Development Commission is the largest among $35,000,000 in construction projects the phosphate rock industry now has under way.

The plant will mark Davison's entry into triple superphosphate production. Total capacity in the industry is estimated currently at 770,000 tons annually. By 1954 Davison's output added to other new and expanded operations will bring the industry's total estimated capacity to more than 1,000,000 tons annually. However, demand by the end of that year is expected to reach 1,600,000 tons, based on forecasts by the United States Department of Agriculture.

Kellogg Book Features Erecting of Refinery

The complex task of erecting a modern refinery is dramatized in a four-color drawing of the job-site featured in the most recent issue of the Kelloggram, just published by The M. W. Kellogg Company. The job is about 75 per cent complete, and the detailed drawings depicts an imaginary 100,000-bbl-per-day refinery and integrated petrochemical plant. It reveals the myriad activities involved in bringing blueprints to reality. It shows welding, radiography, fabricating, guy derricks in action, heat-treating, structural steel work—units on stream—in short, the mammoth job from the ground up.

One section in the Kelloggram deals with the fabrication of a vessel from the time the formed plates are delivered from Kellogg's New Jersey Works to the point where the completed 26-ft diameter, 37-ton section is lifted and then welded into place in a distillation tower. The sequence gives some indication of the painstaking attention to detail required of field forces in just this one phase of putting a refinery together.

REFINING AND GAS PROCESSING

PERSONALS

A. Ludlow Clayden, left, has been appointed technical associate in chemical research department of Sun Oil.

John G. Moxey, Jr., succeeds him as manager of automotive laboratory.

▸ **A. Ludlow Clayden** has been appointed technical associate in Sun Oil Company's chemical research and development department with his assistant, **John G. Moxey, Jr.,** succeeding him as manager of the company's automotive laboratory.

Clayden, a Sun engineer for 30 years, will serve as a staff assistant on problems dealing with automotive matters. An authority on fuels and engines, Mr. Clayden joined Sun in 1922. He became manager of the automotive laboratory at Marcus Hook in 1938.

Moxey, new manager of the automotive laboratory, joined Sun Oil Company in 1935, immediately after his graduation from Swarthmore College, Swarthmore, Pennsylvania. His first job was that of laboratory assistant in the "engine lab" at Sun's Marcus Hook refinery. In 1938, he was transferred to the newly-created automotive laboratory, under the Research and Development department, as a research engineer.

▸ **Robert J. Riggs,** formerly project engineer for Sunray Oil Corporation at the company's general offices in Tulsa, Oklahoma, has been transferred to the company's Sunray (Duncan), Oklahoma, refinery to be chief refinery engineer. Riggs' transfer to Duncan was effective February 1. He joined Sunray in 1949 as a graduate of the University of Tulsa.

▸ **Charles B. Duke** has been appointed manager of the refinery supply and distribution division of Sun Oil Company's manufacturing department. He succeeds Donald Lincoln who died recently.

Edwin H. Sampson, Jr., has been appointed assistant manager of the division in charge of supply, and **Wirt R. Robinson** assistant manager in charge of distribution.

Duke joined Sun Oil Company as a yield clerk at the Marcus Hook, Pennsylvania, refinery in 1934. In 1947 he was advanced to special assistant in the refinery supply and distribution division.

Sampson joined the company in 1931 at Marcus Hook, Pennsylvania, refinery in the yield department. He has been a member of the refinery supply and distribution division since 1939.

▸ **William G. Domask,** Ph.D. in chemical engineering, University of Texas, has been added to the staff at Humble Oil and Refining Company's Baytown, Texas, refinery. Other appointments include: **Harold C. Nix,** Dugway Proving Grounds, and **William A. Burrell,** Buckeye Cotton Oil Company, to technical service division; and **James F. Mathis,** Ph.D. in chemical engineering University of Wisconsin, to research and development division.

▸ **W. V. Ischie,** formerly operating superintendent of Sinclair's East Chicago refinery, has completed his tour of duty with the Petroleum Administration for Defense and has been appointed assistant to the manager of refineries of Sinclair Refining Company. He will make his headquarters in New York.

During Mr. Ischie's tour of duty with the PAD, he served as director of refining in the foreign division.

Gordon R. Henderson

Jan Oostermeyer

R. C. McCurdy

S. C. Harper

▸ **Gordon R. Henderson,** Canadian petroleum engineer, has been appointed manager of Sun Oil Company's refinery now under construction at Sarnia, Ontario. Before joining Sun Oil Henderson was vice president and general manager of Catalytic Construction of Canada, Ltd., directing that company's Canadian activities which include the building of Sun's Sarnia refinery. He had been chief engineer of the Polymer Corporation in Sarnia prior to his association with Catalytic Construction.

Henderson was graduated with honors from Queen's University, Kingston, Ontario, in 1925, as a civil engineer.

▸ **Jan Oostermeyer,** president of Shell Chemical Corporation, has announced his intention to retire May 31 after 36 years of service with various Shell companies. He will be succeeded by **R. C. McCurdy,** now general manager of the Royal Dutch Shell companies in Venezuela.

McCurdy was graduated from Stamford University in 1931, and received his graduate degree in engineer in 1933. In 1939 Oostermeyer became assistant to the president of Shell Chemical, since 1929 a pioneer in the petrochemical field. In 1941 he became vice president, and in 1942 he was named president.

▸ **S. C. Harper** has been appointed manager of the manufacturing and oil supply department of the Arabian American Oil Company in New York. He succeeds **D. N. Ezzell** who will return to Saudi Arabia. Harper was in the refining department of The Texas Company for 17 years prior to joining Aramco in 1944. After completing two assignments in Saudi Arabia as supervisor of research and development at the Ras Tanura refinery and as staff manager of refining he was made assistant to vice president of technical and supply services in New York, before his elevation to the managership.

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Personals

R. V. Shankland has been promoted to senior research associate by Standard Oil Company (Indiana). He has been succeeded as section leader on catalyst research and development by **G. M. Webb.**

In the analytical research division, **H. M. Grubb** has been promoted to section leader, and **C. H. Ehrhardt** and **R. R. Hopkins** to group leaders.

Dr. Shankland joined Standard in 1930 as a chemist. He is a graduate of the University of Michigan. Dr. Webb came to the company in 1948. Dr. Grubb, who joined Standard as a chemist in 1938, is a graduate in physics from Purdue University.

Dr. Ehrhardt joined Standard as a senior project chemist in 1949. He is a graduate of Hillsdale College, and received a doctor's degree in physics from Purdue University. Dr. Hopkins joined the company in 1949. He is a graduate of Ohio State University, and received a Ph.D. in chemistry from Columbia.

R. V. Becknell has been appointed manager of the project engineering department of The M. W. Kellogg Company, a subsidiary of Pullman Incorporated, and **O. G. Melchoir** associate manager. Becknell and Melchoir were formerly Kellogg project managers. Becknell will serve as administrative head of the department and in addition will be technically responsible for the project engineering on all company contract work in North, South, and Central America. Melchoir will be technically responsible for activities in Europe.

G. H. Branscombe and **N. W. Lewis,** formerly job engineers, have been named project engineers.

Dr. Louis H. Goodson, senior chemist at Midwest Research Institute, has been chosen by the Voice of America to prepare a radio program on chemotherapy in cancer, it has been announced. The program will be beamed at the Far East and European areas.

John B. Okie, vice president and director of World Commerce Corporation, has been named a director of Houdry Process Corporation. During World War II, Okie was attached to the American Embassy in Portugal and Spain. In addition, he spent some 12 years in South America and Europe.

Dr. Richard C. Back has been appointed to the product development staff of Ethyl Corporation, it is announced. Dr. Back, an entomologist, will serve under Dr. Charles L. Smith, associate director in charge of agricultural chemicals.

F. W. Kavanagh has been appointed manager of petroleum products research, development and technical services divisions at the Richmond laboratories of California Research Corporation. He succeeds **A. H. Batchelder,** who was recently elected a vice president of this Standard Oil Company of California subsidiary.

Kavanagh, an engineering graduate of the University of California, joined Standard in 1930.

Gas Transmission Control Problems

Improved instrumentation is resulting in greater accuracy and dependability in compression and dehydration

J. PROCOPI* and W. W. DRAKE*

COMMERCIAL discovery of natural gas in the United States is first recorded in the history of the year 1821. It is amusing to reflect that when this initial commercial well was brought in at Fredonia, New York, the sum total of controls consisted of a large tin barrel—thrown over the well in order to hold the pressure.

In the more than 100 years that have elapsed, continued drilling and exploration have unearthed vast quantities of natural gas, such that today the current proved reserves are estimated to be greater than 200 trillion cubic feet. There can be no doubt that drilling and exploration activities are intensifying yearly, and that natural gas is fast becoming one of the most important sources of energy in the United States.

The problem of transporting this natural gas from its major concentration areas in Texas-Louisiana to industrial and domestic users throughout the country has fostered a boom era in pipe line construction. Many thousands of miles of underground arteries have been built, with perhaps bigger and better ones still to come. Today, long line gas transmission systems alone are handling more than one billion cubic feet of gas every day.

Because efficient gas transmission, as well as cost-correct gas sales and purchases, is closely linked with instrumentation, transmission company engineers and instrument manufacturers are constantly striving to improve accuracy and dependability in the instruments on which so much of gas pipelining depends. Many other less active industries are reaping the rewards of this improved instrumentation, brought about through the ingenuity and ceaseless effort of instrument men in the pipe line industry.

Nature of Control Problem

Control problems in natural gas pipelining confine themselves to two main areas: (1) Gas dehydration and (2) gas compression. There is a tendency to lay toward the use of the so-called "packaged" plant for gas dehydration, where the dehydrator vessels, gas lines, control instruments, control lines, and valves are designed and engineered as a unit, requiring very little more than just connection into the main pipe line.

In like manner, each compressor station along a gas transmission line can be looked upon as a small processing plant, although generally representing a more sizable investment in capital equipment than the dehydration plant. One company is manufacturing a packaged compressor plant, however, mounted on skids and completely self-sufficient.

Compressors and their prime movers, together with water treatment plants, and jacket water cooling, and other cooling systems, present numerous problems in instrumentation, the solutions of which all point toward the goals of (1) automatic operation with all key variables under control, and (2) efficient operation with minimum maintenance and maximum safety of personnel and equipment. These two aims, of course, are also true of the dehydration plant.

Gas Dehydration

All natural gas produced from gas bearing sand is usually saturated with water vapor at the operating pressures and temperatures, necessitating dehydration of the gas prior to its transmission. This elimination of water vapor prevents freezing or the formation of hydrates, which can block the line. At the same time, the dehydration of the gas to a certain prescribed dewpoint will result in a minimum of line and equipment corrosion.

Typical Plant Design. One of the more commonly used dehydration systems is an absorption type that utilizes a solid desiccant. In the particular unit illustrated, operation of the plant is basically cyclic in nature with two towers or contactors being used alternately.

One tower is kept on stream until its bed of solid desiccant is saturated; then it is switched off to be regenerated while the second tower is simultaneously placed on stream. In the switching process, involving 12 on-off type diaphragm motor valves, the need for reliable automatic control to supplant manual operation is paramount. In addition, temperature and flow must be constantly regulated in the system if uniformly dried gas of the proper specifications is to be obtained.

Shown in the accompanying photograph and schematic diagram (Figs. 2 and 3), essential components of the dehydration plant comprise: (1) two contactors ranging in diameter from 2 to 4 ft and in height from 12 to 16½ ft, depending on the plant capacity, (2) a gas-fired heater for regenerating gas, and (3) a regeneration gas cooler where dehydrated gas is heat exchanged with gas from the tower under regeneration. Not shown on the diagram are two additional units of the plant, namely: an

EXCLUSIVE

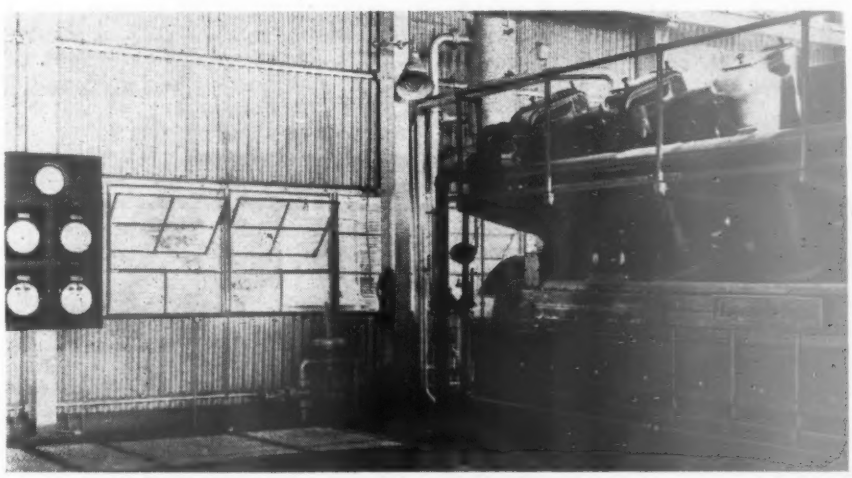


FIG. 1. Recording thermometer, flowmeter, and pressure gage panel mounted near gas compressor.

*Petroleum industry engineers, Minneapolis-Honeywell Regulator Company, Industrial Division.

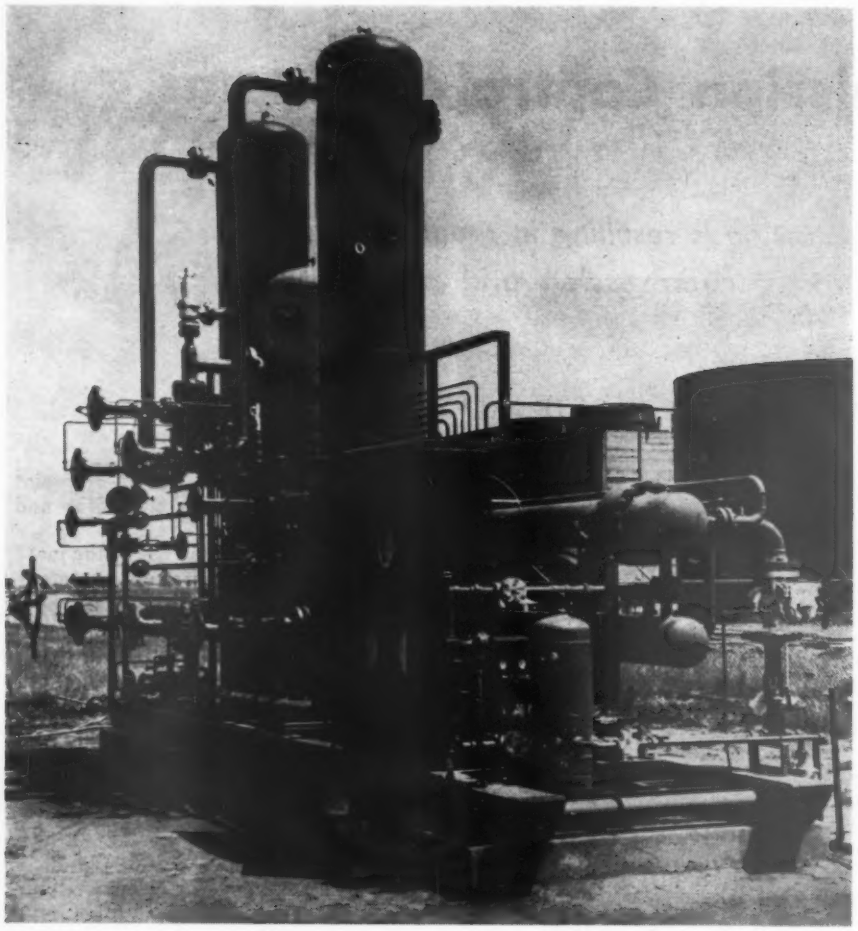


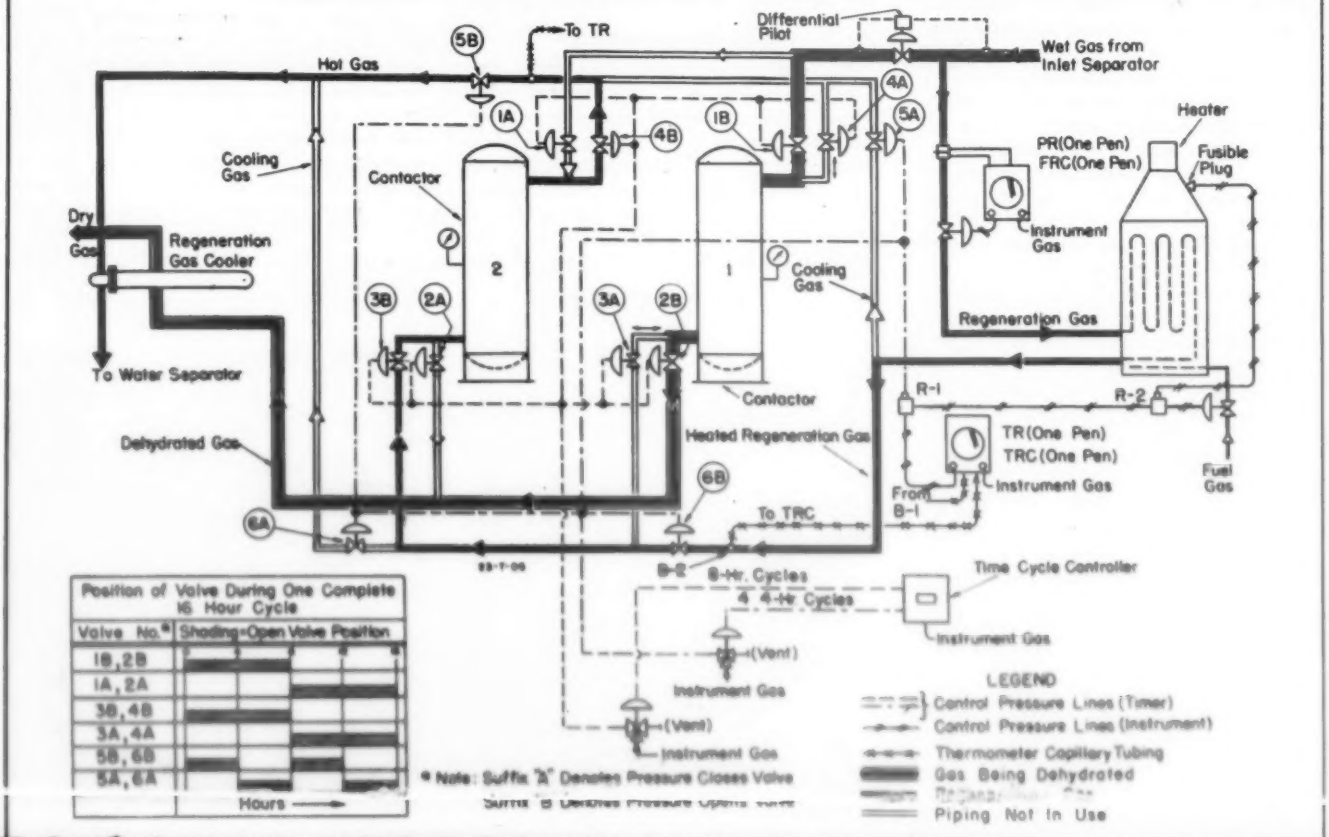
FIG. 2. Package dehydration unit, complete with control cubicle.

inlet separator, which removes oil and entrained solids from the incoming wet gas, and a water separator, which removes moisture accumulating from the regenerating gas.

The process, described in more detail below, basically involves a 16-hr operating cycle, with each contactor on stream for 8 hr, while the other is being regenerated for 4 hr and cooled for 4 stream of natural gas bypassed off the main line wet gas and heated to 350 F prior to its passage through the desiccant bed in the contactor. All equipment is operated under a pressure of 800 psi.

One general feature of the instrument system is its complete independence of outside sources for power. All clocks for chart drives and operation of the time cycle controller are 7-day, spring driven. Control gas for the pneumatic instruments and fuel gas for the heater in the system are supplied from a line tapped off the dehydrated gas line, the pressure being reduced in two stages from 800 psi to 25 psi by means of conventional pressure-reducing valves.

Time Cycle Control. Operating sequence of the on-off type diaphragm motor valves that serve to switch contactors (coded by number-letter combinations on the diagram) is monitored by a time cycle controller through two control manifold systems, as shown. This timer instrument contains two poppet valves operated by cams that are rotated by means of a 7-day spring-driven clock. Connected to the diaphragm motors of two separate three-way valves, output gas pressure from the cycle controller is either applied or bled through



these poppet valves—thereby governing whether full 25 psi gas pressure or zero pressure is maintained in each of the manifold lines to the diaphragm motor valves that switch the contactors.

To follow the cycle of operation in detail, it will be assumed that No. 1 contactor is on stream. Main flow of gas is down through valve 1B, into No. 1 contactor, and out the bottom through valve 2B. Thence, the dehydrated gas flows out of the system, passing through the regeneration gas cooler. This flow continues for 8 hr.

No. 2 contactor is cut off from the main gas stream by valves 1A and 2A, which are closed. To provide heated natural gas for regeneration of this unit, some 10 per cent of the main gas stream is diverted by means of a diaphragm motor valve installed in the main gas stream. This valve is positioned by a "differential pilot" that operates from pressure taps downstream on the main flow line and upstream at the inlet separator; sufficient back pressure is thereby created to provide the bypass flow of gas for regeneration.

Four-Hour Regeneration and Cooling Periods. As shown on the diagram, regenerating gas flow is controlled by a Brown mechanical flow meter (FRC) operating a diaphragm motor valve. The meter also incorporates a pressure spiral and second recording pen for logging the system pressure of about 800 psi. The gas passes through coils in the heater, and then branches into two flow lines, up toward valve 5A and down toward valve 6B. For the first four hours, however, valve 5A is closed, so that flow is only in the lower line through valve 6B, which is open during this same period.

Further, as seen from the chart of valve positions, valve 6A in the lower line is closed, thereby diverting the heated gas up through No. 2 contactor via valve 3B on the bottom inlet line. The latter valve, as well as the valve 4B on the top outlet line of the contactor, is open for the full 8-hr period, and during the first 4 hr permits the flow of heated regenerating gas up through the contactor bed. Moisture laden hot gas passes out through valve 5B, being cooled by heat exchange with dehydrated gas in the regeneration gas cooler, as shown.

During the second half of the 8-hr period, the dried bed of No. 2 contactor is cooled by the flow of unheated regenerating gas, which passes up through valve 5A, down through the contactor via valves 4B and 3B, and thence through valve 6A on out of the system to the gas cooler. This operation is initiated by the time cycle controller, which closes the fuel gas line to the heater, as described below, and cuts off the 25 psi gas supply from one manifold line to reverse the positions of the appropriate diaphragm motor valves (see diagram).

Temperature Control of Regenerating Gas. A mercury-filled Brown thermometer (TR-TRC), range 0 to 500 F, serves to record and control temperature of the regenerating gas, as well as to record on the same chart, temperature of

a stainless steel bulb, B-1, inserted in the common line from the two contactors, as shown on the diagram. As hot gas dries out the desiccant, this bulb serves to record the gradual temperature rise and leveling off when the bed is dry from top to bottom. Thus, it will indicate the drying rate, which can be adjusted by changes in the set point of flow controller FRC.

For temperature control of the regenerating gas, a second bulb, B-2, is situated in the heater outlet line ahead of valve 6B, as shown. A narrow band proportional control unit in the Brown recorder throttles control gas that normally passes directly to the fuel gas control valve through pneumatic relays R-1 and R-2 (Honeywell Type RO48A). In accordance with the temperature set point of TRC, the fuel valve is thus positioned to maintain a constant temperature of regenerating gas.

Pneumatic relay R-1 serves to cut off control gas from TRC and thereby close the fuel gas valve at the end of the 4-hr regeneration period. This is accomplished by connection of the relay pilot in the impulse line from the time cycle controller, as shown. Pneumatic relay R-2 also serves to cut off control gas from TRC through the action of a fusible plug, which is installed to melt at 1100 F to 1125 F, thus venting instrument gas pressure in the event of excessive heater stack temperature.

Gas Compression

In transporting natural gas through pipe lines, initial gas pressure is reduced as a result of line friction. Accordingly, compressor stations situated at strategic points along a pipe line recompress the gas to or near its initial pressure. At these stations, instrumentation is employed to maintain constant pressure on compressor suction and discharge, and to remove any entrained liquid still present in the gas or picked up in the system before it reaches the compressor cylinders. Many safety devices are employed such as pop valves and relief valves. In addition, cooling water control for engine and compressor jackets, as well as other temperature measurements, are utilized in the overall system operation.

Gas Pressure Measurement. Incoming gas pressures are controlled in order to maintain a constant load on the individual compressors. An air-operated controller with proportional band and automatic reset is usually employed in conjunction with a diaphragm motor-operated control element (usually a butterfly valve equipped with positioner).

A two-pen pressure recorder may be employed to log suction and discharge pressures of the compressor. Recent studies in gas pulsation have indicated methods for reducing the unfavorable pulsation factor, but means can also be provided in the instrument to avoid a "paint-brush" effect on the chart record, caused by rapid fluctuation in pressure.

Discharge pressure control can be effected by a pressure recorder-controller, which sets individual engine speed governors by means of diaphragm

justs the engine's speed when it is necessary to compensate for variable operating conditions. As close control of discharge pressure is required, the instrument control mechanism usually incorporates automatic reset. Oftentimes, a pneumatic manual operating panel is provided for each engine in order that the speed of any engine may be manually controlled while others are under automatic operation.

Other instruments are utilized on scrubbers, which are installed on suction of compressors and on discharge of each stage. These scrubbers collect any liquid before it reaches the compressor cylinders, and should be equipped with a protective device to prevent damage to the compressors, in case of failure of the liquid removal equipment. In plants that are constantly attended, a high float provides an audible alarm. In unattended stations, a high float can be made to actuate a switch, thus grounding the magnetos and stopping the compressor engine. Other secondary control apparatus usually consists of thermal protective devices on pump bearings, motor bearings, pump-case temperatures, and stuffing boxes.

Jacket Cooling Water Temperature Control. With engine-driven reciprocating compressors, it has been conclusively demonstrated that close control of jacket cooling water temperature reduces maintenance costs. Many mechanical difficulties formerly encountered without such control, such as piston seizure and cracked cylinders, are eliminated with automatic temperature control.

The varieties of open and closed cooling systems employed in compressor stations have resulted in numerous different temperature control systems. In general, however, control is accomplished by varying the amount of jacket water that is cooled, based upon measurement of the water temperature. For such control, a recording thermometer is equipped with a control unit for air (or gas) operation of a diaphragm motor valve. In a closed system, for example, the valve would be on a bypass line around the cooler.

In many of the newer stations, engine lubricating oil temperature is automatically controlled by a recording thermometer, which regulates a control valve on the oil flow through a water-to-oil heat exchanger. In addition, blind pressure controllers are used to actuate alarms, or shut down the engines, when lube oil pressure drops below or exceeds certain preset limits.

One gas transmission company, using a closed system that combines cooling of water for engine oil coolers, engine jackets, and compressor jackets, has employed a Brown ElectroniK controller in a unique fashion for temperature control of the engine and compressor jackets. Extremely fine control is accomplished by using very accurate resistance thermometer bulbs on both the jacket inlet and outlet water lines, the two bulbs being connected so that the temperature differential is measured. This company believes that actual tem-

tions are obtained and only three or four washes are needed. Save the salt washes and wash once with absolute ether; then discard the salt washes. Now wash this last ether wash with small portions of the 10 per cent potassium chloride solution until free from acid. Discard these last salt washes but add the ether to the rest of the ether solution containing the separated fatty acids.

Dry the ether solution with small bits of torn filter paper, dry filter paper pulp, or anhydrous sodium sulfate. (The anhydrous sodium sulfate is a good drier but care must be taken to prevent traces of it from contaminating the fatty acids in case sulfur is to be determined on them.) Filter the dried ether solution through a coarse paper if filter paper or pulp was used for drying. Use a finer paper if sodium sulfate was used for drying. In either case, collect the filtrate in a tared beaker, evaporate off the ether on the steam bath using an air jet to prevent foaming and to hasten evaporation, and finally dry in an oven at 105 C for about an hour. Weigh the cooled beaker. The gain in weight represents the separated fatty acids.

Calculations

$$\text{Fatty acids, \%} = \frac{\text{grams fatty acids}}{\text{grams sample}} \times 100$$

Discussion

The procedure given is capable of yielding satisfactory results on a wide variety of samples. The use of absolute ether where prescribed in the procedure has been found necessary in order to obtain a product free of esters.

The fatty acids obtained are generally dark colored. They may be purified by means of a petroleum ether separation. Dissolve the fatty acids in petroleum ether, filter off the petroleum ether insolubles and evaporate off the petroleum ether in the filtrate to obtain the purified fatty acids. The yield of purified material is usually only a little less than the original and usually has a better color and appearance.

The fatty acids isolated by the above procedure may be identified in most cases by submitting them for a series of appropriate physical and chemical tests.

P. 265.

DETERMINATION OF ASPHALT CONTENT OF A LUBE CRUDE OIL RESIDUUM

F. J. HIGGINS*

THIS method has been developed and successfully used by Continental Oil Company for the determination of the asphalt content of lube crude oil residua. It produces a constant asphalt figure, based on the crude, when the determination is made on any length of lube residuum. The asphalt is determined from the color of three or four naphtha solutions of a lube residuum, which have been contacted with different quantities of Filtrol contact clay and the colors of which fall within a prescribed color range. This is an empirical procedure which depends upon the fact that contact clay will deasphalt a crude oil residuum by adsorption, with subsequent decrease in naphtha solution color in proportion to the asphalt adsorbed.

The method was originally based on the observation that, for the several residua first investigated, a point was reached where additional clay added to a naphtha solution of a residuum affected the viscosity of the remaining oil relatively little. Colors of the oil-naphtha solutions were observed at this point of small viscosity change, and a color range was chosen which indicated this condition. The colors were measured with a Klett colorimeter using a number 54 green filter, standard Klett test tube, and naphtha for zeroing the instrument. The color range where little change in the physical properties of the deasphalted oil occurs is 120-150 Klett color. Material removed versus color of the oil solution was plotted. From this plot, the material removed at a Klett color of 135 was considered to be asphalt.

The specially prepared scale for plotting the data is printed on 8½ in. by 11-in. paper and has a linear scale along the 8½ in. side for plotting color and a restricted range of normal probability scale along the 11-in. side for plotting per cent asphalt. Ranges are 0.5 per cent to 10 per cent, 1.5 per cent to 15 per cent, 6 per cent to 30 per cent, and 15 per cent to 50 per cent.

Specially designed hot plate for naphtha evaporation.

The quantity of material removed is determined by evaporation of an aliquot of the clay deasphalted naphtha-oil solution to determine the per cent of oil. The difference between the original sample and its oil content is the material removed by the clay.

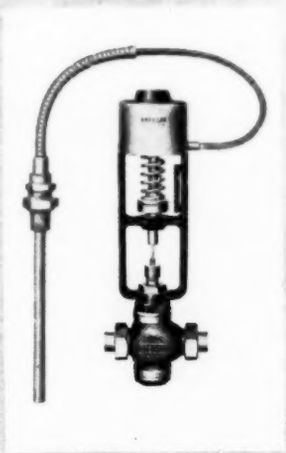
This method has been used by nontechnical personnel, having a high school education or equivalent, for the last seven years for routine crude oil evaluations. It has been very successful. The total elapsed time required for one determination is about eight hours. The person making the determination has some of this time free for performing other duties.

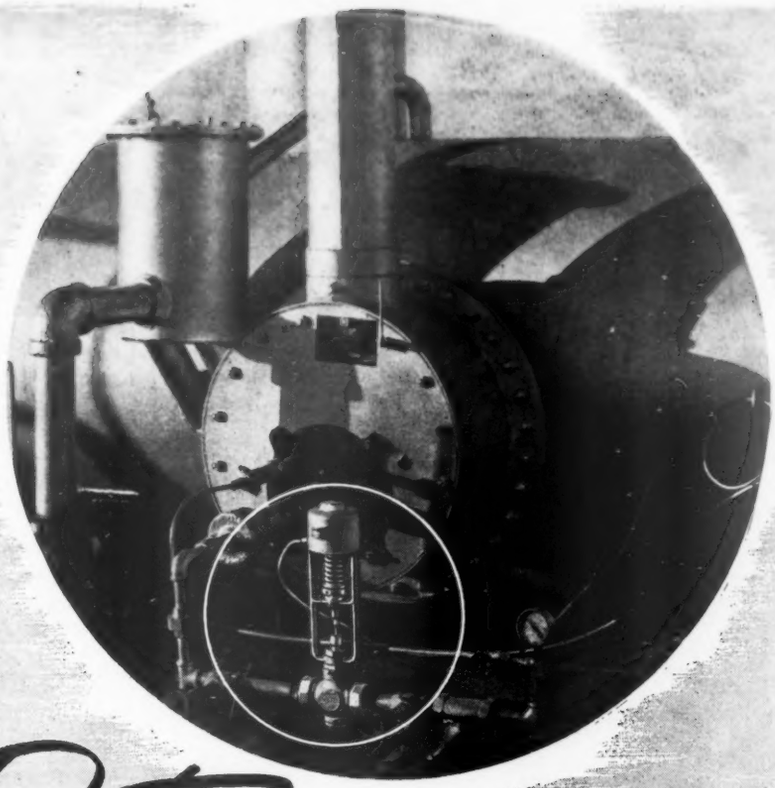
Procedure

Weigh a 25-g sample of lube residuum into each of five weighed 1-liter Erlenmeyer flasks and warm in an oven at about 200 F. Add 375 ml of ASTM precipitation naphtha to the first flask and cool the solution to 95 ±2 F. Contact this solution with well-mixed Filtrol contact clay in small weighed increments agitating for one to two minutes after each addition of clay until a color break occurs. (The quantity of clay required varies from less than 100 per cent up to 1000 per cent of the 25-g sample for high asphalt residua. If it is observed that a large quantity of clay will be necessary to reach a color break, increase the size of the incremental clay additions.) Filter a portion of the solution and determine its Klett color using a Klett test tube, Klett No. 54 green filter, and ASTM precipitation naphtha for zeroing the instrument. From this quantity of clay relationship to color, select four different quantities of clay for the remaining four flasks, which will produce Klett colors differing approximately equally from each other and falling within the range of 70 to 250. Add one of the four predetermined weighed amounts of clay, respectively, to each of the remaining four samples in one addition. Place the flasks in a shaking machine for one-half hour. A vented neoprene stopper in each flask prevents loss of material by splashing. Allow the samples to settle for 15 min after shaking, then weigh. Decant approximately 100 ml of each solution into separate centrifuge tubes and centrifuge for 5 min at 1500 rpm. Determine Klett colors of each solution after centrifuging. Pour approximately 75 ml of the centrifuged solutions into weighed 250-ml Erlenmeyer flasks. Determine the weight of each aliquot and place the flasks on a 220 ±10 F hot plate. Evaporate the naphtha by pulling air with a vacuum through the flasks at a rate of 5 ±1 liters per minute. Continue the evaporation for hourly intervals until constant weights (within 10 mg) are reached.

The accompanying photograph illustrates well the specially designed hot plate that is used for the naphtha evaporations. The flask adapters fit conveniently into the vacuum connections attached to the back of the plate. Of course, any temperature-controlled hot plate can be used.

*Associate research chemist, Continental Oil Company.





On Duty 'ROUND THE CLOCK . . .

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The temperature of this oil treater is *constantly* maintained within prescribed limits. Such safe, dependable service is assured by the self-operated, precision-built American Temperature Regulator. A turn of a conveniently placed adjustment nut sets the temperature. And, to duplicate any setting easily and quickly, a scale is mounted on the Regulator frame. Between the bellows and adjusting spring is a safety spring that protects the Regulator if the bulb is accidentally subjected to excessive temperature. Damage and disturbance of the set temperature are prevented by heavy armor that safeguards the capillary tubing and seamless bellows.

American Temperature Regulators give positive temperature control of oil, water, steam and other media — help maintain product quality and reduce costs. Sizes range from ¼" through 4". Two types of valve action available: *direct action* for use in *heating* processes; *reverse action* for application in *cooling* processes. Both types are ruggedly constructed, efficient and dependable. Bulletin 112 contains complete data, including selection tables. To be certain of safe, economical processing, let your nearby American Instruments Distributor help you choose the right American Temperature Regulator for your needs.

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Your questions on refining and gas processing problems answered here. Send yours in today!

TECHNICAL FORUM

Cleaning Asphalt-Handling Equipment

Q An asphalt-road oil unit is being revamped, and it is desirable to clean thoroughly the old equipment to be reused, including valves, fittings, heating and steaming coils, lines, tanks, and blowing vessels. What is the best procedure to follow in cleaning and reconditioning this equipment? Lines contain up to an inch or so of asphaltic material, but are open, so are valves. Tanks and blowers have an inch or so of tarry material in the bottoms, and considerable amounts clinging to the side walls.

—E. L. T.

A The cleaning of an asphalt road oil unit is a difficult task to perform, particularly where the deposit is of a solidified nature. This does not mean that the problem is an impossible one, but *it is always best to get the recommendations and methods for doing this work from the manufacturers of cleaning compounds.*

In our opinion the following steps will have to be considered:

1. The correct cleaning material will have to be selected and usually a combination must be employed.
2. It is advisable to circulate the solution through those vessels and lines with good velocity as the turbulence created removes the interfering deposit at a much faster rate than a still soak. A pump capable of discharging the solution at a rate of 200 gal per minute will greatly reduce time of cleaning operation.
   A still soak tank method will have to be employed to clean that equipment that does not lend itself to the circulating method.
3. Solution temperature is as important as the selection of the cleaning materials. The cleaning materials are designed to be used at a certain minimum temperature and if this is not reached it is quite probable that a failure will result.
4. Too much stress cannot be placed on the time of solution contact. Use as much time as possible.
5. A hot rinse at not less than 200 F usually removes the suspended deposit that has been softened by the solution.
6. It is important, and advisable, to consult with the representatives of cleaning material manufacturers as his opinion and sometimes chemical tests, will determine the proper material and method to use.

As a long range analysis of this problem we are of the opinion that the following cleaning materials and suggestions would greatly assist the person submitting this question:

a. Circulate hot water at 200 F through the equipment for 2 hours. Then drain to sewer.
b. Circulate a solution of Oakite Composition No. 19 at 8-12 oz per gallon. After complete circulation has been obtained, add 10 per cent of Oakite Composition No. 8 to the stock solution and bring temperature up to 190-200 F. Circulate for 16 hours. Then drain to sewer.
c. Duplicate Step A.

—V. E. Bowes.

Separation of Naphthenic Acids

Q Please give a satisfactory system for the separation of naphthenic acids from a middle or heavy petroleum fraction, including apparatus, reagents, and routine of attack on the problem. How may a mixture of these acids, so separated, be purified? Will appreciate a few literature references on the problem of isolating the more common individual acids. — M. C. F.

A Fundamentally the separation of naphthenic acids from middle or heavy fractions of petroleum involves neutralization of the acids by dilute sodium hydroxide, separation of the resulting water layer containing the sodium salts from the hydrocarbon layer, liberation of the acids from the sodium salts by addition of sulfuric acid, and final separation of the layer of liberated acids from the water.

Actually any acid obtained would be so badly contaminated by phenols, hydrocarbons, sulfuric acid, and other inorganic compounds dissolved or emulsified during the operations listed that the product could probably not be sold.

To obtain a salable product a batch process is usually used. This permits gentle agitation to get complete reaction without excessive emulsification, use of a settling period that yields clearly separated layers, and use of slightly less than enough 5-10 per cent base to neutralize all of the acidity so as to reduce the concentration of phenols in the acids. To cut down the settling time required the tank may be heated to 60-80 C but in the case of heavy fractions from some crudes emulsions are so troublesome that alcoholic sodium hydroxide solutions must be used thus increasing the cost so much that commercial production of acids is not feasible.

Emulsions again occur when the acids are liberated from the sodium salts by fairly concentrated sulfuric acid, but this results mainly in lower yield rather than in impure acids. Air blowing to be followed by water washing to remove sulfuric acid may clarify the acids.

In spite of these precautions the naphthenic acid concentration of commercial acids ranges from 95 to 65 per cent, the impurities consisting mainly of phenols and hydrocarbons dissolved or emulsified in the acids. Dark color may be partly removed by treatment with clay.

If further refining is needed, this is usually carried out either by treatment with a small amount of concentrated sulfuric acid or by distillation. Neither of these processes removes hydrocarbons but the acid treatment removes nearly all phenols, sulfur compounds, and nitrogen compounds that may have been present.

Distillation usually yields a lighter colored product and, since fractions are collected, a narrower boiling mixture but distillation has to be carried out in vacuum thus increasing costs materially.

If individual acids are to be isolated, much additional refining and fractionation is required. Usually the steps involved are conversion to sodium salts in alcoholic solution and washing of this solution with low boiling hydrocarbon to remove non-acidic impurities, liberation of the purified acids, preliminary fractionation in vacuum, conversion to the methyl esters, careful fractionation of the esters, also in vacuum, separation of the individual ester fractions or the acids derived from them by some different separation process such as countercurrent extraction or chromatographic separation and final conversion to a solid derivative or salt, which may perhaps be purified and the acid identified.

Actually no naphthenic acid with more than ten carbon atoms has been identified and the procedures listed above are probably the *minimum* number of separations required. The attached references include some of the many attempts, some partially successful, that have been made to identify naphthenic acids from petroleum fractions.

H. L. Lochte.

References

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6. Nenitzescu, et. al., Ber. *71B*, 2062 (1938).

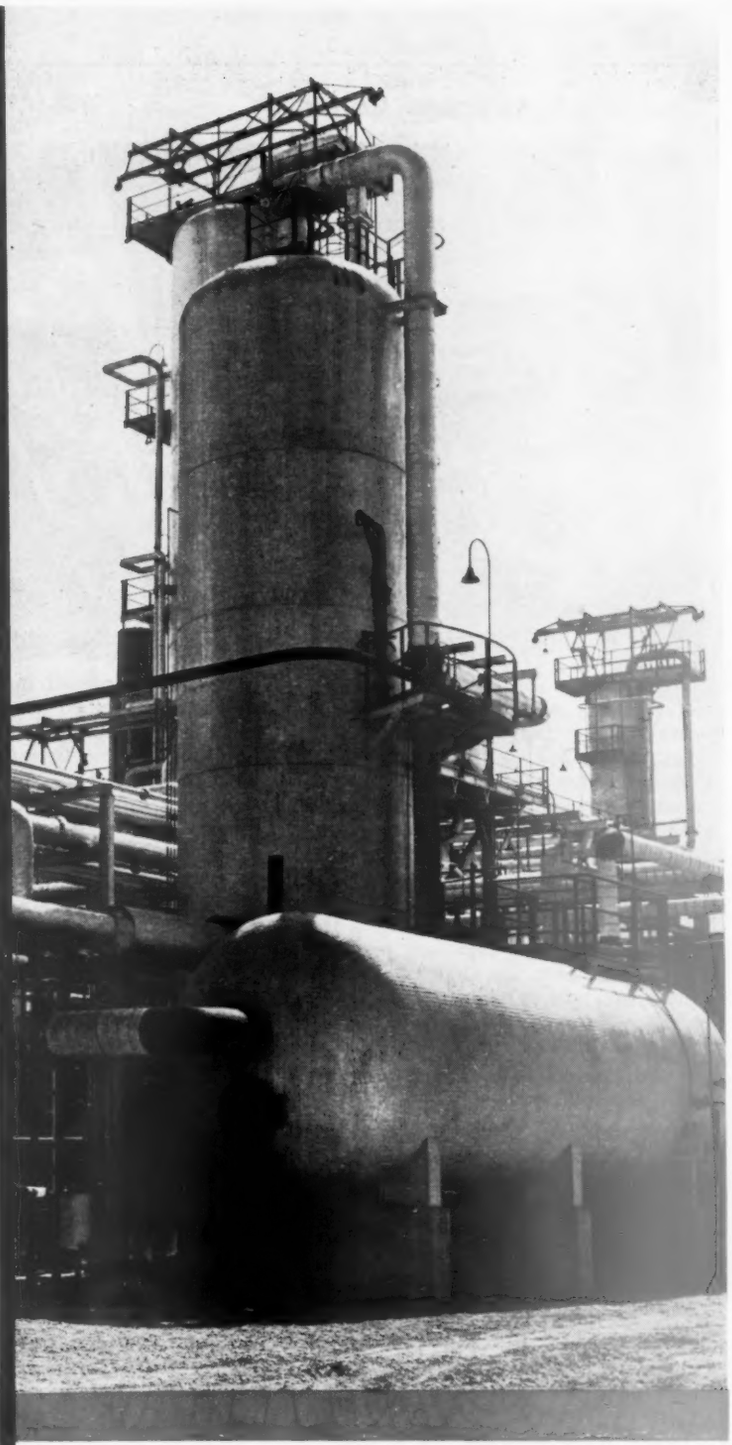
WHEN YOU NEED *Desalting*

BE SURE YOU GET SERVICE

Desalting, like any other refining process, should be designed, supervised and serviced by specialized experts. Many years of chemical desalting experience have convinced the Tretolite Company desalting engineers that complete service is necessary if efficient desalting is to be attained. Since the Tretolite Company pioneered chemical desalting, and since Tretolite currently is being used to desalt over a million and a half barrels of crude per day, we believe that these conclusions have a factual foundation.

The attainment of efficiency in chemical desalting just begins with the preliminary tests, specification and sale of the treating chemical. The treating plant must be designed to give the most efficient flow, proper heating, correct contacting and necessary residence time. All these are factors of design — important factors with which Tretolite desalting engineers are fully conversant.

At Tretolite, we believe that we can *sell* you the best desalting chemicals available; we will *give* you the best service.



Tretolite Desalting Service provides:

1. **Preliminary performance-prediction tests**
2. **Plant design assistance, drawings and consultation**
3. **Construction advice and supervision**
4. **Technical assistance for the "start-up"**
5. **Instruction of refinery personnel**
6. **Continuing service and periodic inspections**

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Chemicals and Services for the Petroleum Industry

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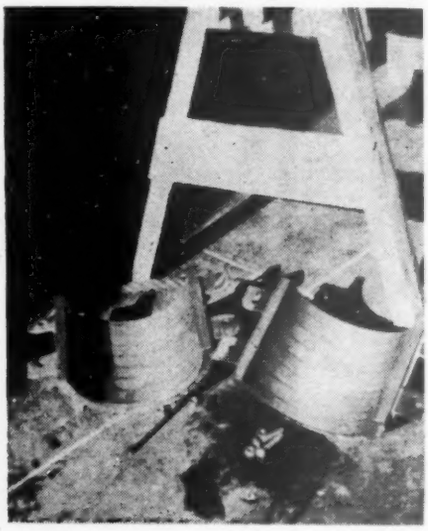
Crankshaft Lapping Collar[1]

Purpose: For grinding out ridges in engine crankshaft.



Description: The crankshaft lapping collar, which is shown above, was improvised for grinding out ridges on a Worthington DDG-8 crankshaft. These ridges were too hard to be filed off. The collar was machined from cast iron to exactly the size of the piston rod bearing. Spiral grooves were turned in opposite directions from each end inside the collar. Bolts fastened through lips running lengthwise along each side of the collar are used for adjusting pressure of collar against the shaft. Ropes attached to opposite sides of the collar complete the assembly.

To put this device into use, lapping compound is placed in the collar and the collar clamped to the crankshaft. Bolts on the collar are tightened to give the desired pressure and a man placed on each rope. The collar is then seesawed back and forth for about ten minutes. The engine is then jacked over one-eighth revolution and the grinding procedure repeated. The spiral grooves tend to work the lapping compound back and forth in the collar without allowing it to work out either end. As the crankshaft is ground down, bolts are periodically tightened on the collar. Lapping compound is cleaned out and the crankshaft checked with micrometer approximately every thirty minutes.

[1]NGAA—Permian Basin regional meeting.

Computing Gas Volumes[2]

RAY E. SCURLOCK[3]

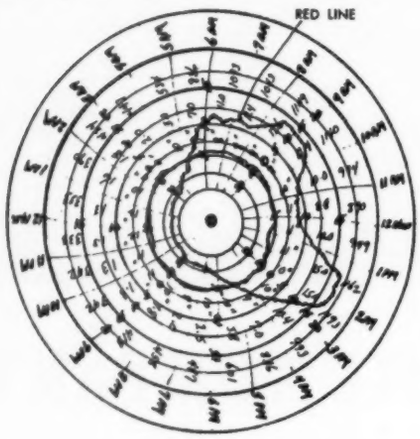


FIG. 1

Figures	72
Extensions added	24
Total figures	96

FIG. 2

Figures	24
Extensions added	24
Total figures	48

Purpose: To save time computing daily plant master meter charts.

One of the first things that the superintendent of natural gasoline plants would like to know each morning is how much gas was processed during the last 24 hr, the production, yield, and the rate of gas to the plant each hour. Naturally the plant report will have to be figured and the charts computed in order to furnish him with these figures. With these figures, he can note any irregularities, and have them corrected at once. The yield, gas and the rate of flow to the plant cannot be furnished until the charts have been computed.

Referring to Fig. 1, this chart is read the usual way by reading the static and the differential. By using these two figures and the pressure extension book, the extension is located. The extensions are added and the total is multiplied by the coefficient for that particular chart to arrive at the gas volume. This method was used and for computing 13 plant master meter charts, the average time was 65 min, using a total of 1248 figures.

Referring to Fig. 2, the chart was placed by the pressure extension book, and by reading the static and the differential, then quickly glancing at the pressure extension book, the extension was written down on the chart. The same 13 plant master meter charts were computed by this method on an average of 35 min, using a total of 624 figures. The method used in computing the charts on Fig. 2 has been checked with an integrator, and the gas volume has been very close.

[2]Class B third prize winner at NGAA.
[3]Chief clerk, Warren Petroleum Corporation, Gladewater, Texas.

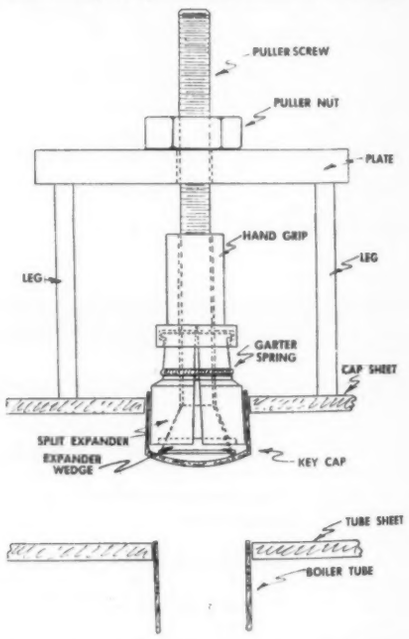
Boiler Type Installer[4]

H. C. RATTO[5]

Purpose: To install key caps in the cap sheet of shipping board boilers.

Description: A "puller" type tool that inserts, and then expands to a tight fit, the key caps at the boiler tube ends in the cap sheet.

It permits all caps to be drawn into cap sheet as opposed to sledge hammering. It eliminates rolling of leaky caps, reduces a two-man to a one-man job, reduces time necessary for this operation by 50 per cent, eliminates sledge hammer damage to caps, straightens bent caps, and eliminates the safety hazard of manipulating a sledge hammer in a semi-awkward position.



The tool has proved itself in use.

[4]Class A, third prize at NGAA—Permian Basin regional meeting.
[5]Roustabout, Phillips, Odessa, Texas.

Work Proceeds on Standard North Dakota Refinery

Standard Oil Company's Mandan, North Dakota, refinery payroll will be about a million dollars a year, T. E. Stockdale, manager, predicted here recently.

While October 15, 1954, is specified as completion date for all construction work, operation of the refinery may get under way earlier, he said.

Speaking on "Mandan's New Enterprise" at the annual meeting of the Mandan Chamber of Commerce, the Standard executive also announced the construction schedule of the projected 30,000-bbl a day refinery:

1. Ground breaking and grading of site—April, 1953, or earlier if weather permits.
2. Pouring concrete foundations for storage tanks—early summer, 1953.
3. Completion of warehouse and shop —before winter, 1953.
4. Start of delivery of special equipment—fabricated meantime at various points throughout the U. S.—winter, 1953.
5. Specified completion date for all construction, and "on stream" operation —October 15, 1954.

Additive Plant Announced

The Lubrizol Corporation has acquired a site of 17 acres in the vicinity of Niagara Falls, Ontario, and will build an additive plant representing an initial investment of around $400,000, President Kelvin Smith announced. The new plant will produce a full line of motor oil and gear lubricant additives for Canadian refiners. It will be the first plant to manufacture these products in Canada.

The Canadian company will be known as Lubrizol of Canada, Ltd., and will have the same staff of officials as the parent company. These are Kent H. Smith, chairman of the board; Kelvin Smith, president; F. Alex Nason, senior vice president; Thomas L. Holland, vice president sales; Arthur O. Willey, vice president—engineering; Clyde H. Britten, vice president—manufacturing; David K. Ford, secretary, and Russell J. Ferree, treasurer.

Radiation Effect on Lubricants Tested

The West's first high-intensity industrial source of gamma radiation, one of the kinds of rays given off by an atomic "pile," is now being used by California Research Corporation to test the effects of irradiation on lubricants and other materials likely to be exposed to radioactivity in an atomic engine.

Cal Research, subsidiary of the Standard Oil Company of California, is carrying on the experiments at its laboratories in Richmond under a contract with the Atomic Energy Commission.

The radiation source has been supplied to Cal Research by the AEC for the duration of the project. Previously, materials employed in industrial atomic research had to be sent to one of the AEC's own installations for irradiation.

Chemical Group Forms Dallas, Texas, Club

The Dallas Chemical Engineers Club has been organized by some 60 of the 130 chemical engineers residing in the Dallas, Texas, area, Harold A. Blum, secretary-treasurer of the club has announced. The club will have at least five meetings per year, at which the latest developments in chemical engineering fields will be discussed, and the subject matter will be general and not confined to one or a few industries, the secretary-treasurer stated. Chairman of the club is R. A. Graff, of Graff Engineering Company, of Dallas.

Other officers are: Vice chairman, Robert Purvin, and executive committee, C. F. Tears, Ovid Baker, Sidney Lee, and H. A. Koch, Jr.

Pure to Enlarge Plant

Pure Oil Company of Chicago will construct additional boiler house facilities and auxiliaries at its Toledo, Ohio, refinery.

The work, being undertaken by Catalytic Construction Company, is in connection with new catalytic cracking facilities and new copper oxide naptha treating units now being installed.

The various new units now under construction are the nucleus of a major expansion program at Toledo refinery.

Gamma radiation unit now being used by California Research Corporation, subsidiary of Standard Oil Company of California, to test the effects of irradiation on lubricants and other materials likely to be exposed to radioactivity in an atomic engine.

The radioactive "source," a fourteen inch section of two-inch cobalt tubing, is housed vertically in the drum-shaped lead shield at the center of the photo. Shield weighs two tons. Operator removes long "plug" from the shield by remote control mechanism, preparatory to inserting test material to be exposed to radiation. Door at right is open for photography; it normally remains closed.

United Refining to Build Cat-Forming Plant

United Refining Company has announced plans to build a $1,000,000 catforming plant to produce high octane gasoline in Warren, Pennsylvania.

The new plant, which will use Atlantic Refining Company's catalytic reforming process will have a capacity of 2500 bbl per day of blending stock.

United has specialized in the production of high quality lubricating oils for more than 50 years. With the new catformer the company plans to raise its gasoline production to 3500 bbl per day —double its present output.

Construction and design of this plant is being handled by the Blaw-Knox Company and Blaw-Knox Chemical Plants Division which expects to have the new facilities in operation during 1953.

Tax Write-offs Awarded

Special tax write-offs have been granted to six companies for refinery expansions. National Production Authority awarded rapid write-offs permitting the companies to depreciate their properties for tax purposes in five years.

Companies include: Phillips Petroleum Company, Upton County, Texas, refining facilities, 65 per cent of $4,845,000; Panhandle Oil Corporation, Wichita Falls, 40 per cent of a $29,050 investment; Ada Oil Company, $91,450, 60 per cent; Col-Tex Refining Company, Colorado City, one certificate for 65 per cent of $903,525 expansion and one certificate for 50 per cent of a $30,000 expansion; Phillips Petroleum, Dumas, 65 per cent for $223,000, and in Oklahoma, Mid-Continent Petroleum Corporation, $74,180, 40 per cent.

Chemical Unit Begun

Jefferson Chemical Company, Inc., has announced the start-up of a new general purpose chemical process unit at its Port Neches, Texas, plant. Nonyl phenol is the initial product, and commercial quantities are already available. Other related chemicals may be produced in the unit with but minor field design changes, as market conditions may require.

Nonyl phenol finds increasing use as an intermediate in the manufacture of non-ionic surface active agents, rubber chemicals, and lubricating oil additives, and as a starting material in the preparation of certain resins and plasticizers.

Processing Plant Planned

Tennessee Production Company will build a 100,000,000 cu ft-per-day natural gas processing plant to be situated in the Agua Dulce area, it was announced by O. L. Olsen.

The plant will recover approximately 70,000 gal of liquid hydrocarbons daily. Orders are being placed for materials and equipment and it is expected that construction will be completed and operations commenced during the fall of 1953.

The O. L. Olsen Company of Houston, Texas, has been awarded the contract.

API Compounds Available

New compounds available as American Petroleum Institute Standard samples of organic sulfur compounds as of October 1, 1952. These samples were purified by the American Petroleum Institute Research Project 48A at the U. S. Bureau of Mines, Laramie, Wyoming.

A list of organic sulfur compounds now available may be obtained on request to Carnegie Institute of Technology, Attention of Frederick D. Rossini, American Petroleum Institute Research Laboratory, Pittsburgh 13, Pennsylvania. Orders should be accompanied with full payment in advance, with check made out to the Carnegie Institute of Technology.

Each order should give the following information for each compound wanted: name of compound, number of the samples, size of unit, number of units, price per unit, total cost.

Sample number[1]	Compound Formula	Name	Amount of impurity mole per cent	Vol. per unit[2] ml (liq.)	Price per unit dollars
16-58	C_5H_6S	2-Methyl-thiophene	0.04±0.04	5	$50.00
17-58	$C_5H_{10}S$	Thiacyclohexane (Pentamethylene sulfide)	0.06±0.06	5	50.00
18-58	$C_4H_{10}S$	2-Thiapentane (Methyl n-propyl sulfide)	0.03±0.03	5	50.00
19-58	$C_4H_{10}S$	2-Butanethiol (sec-Butyl mercaptan)	0.1 ±0.1	5	50.00
20-58	$C_4H_{10}S$	3-Methyl-2-thiabutane (Methyl isopropyl sulfide)	0.01±0.01	5	50.00
1021-58	C_5H_{10}	1, trans-2-dimethyl-cyclopropane	0.23±0.12	5	50.00
1022-58	C_9H_{16}	trans-hexahydroindan (trans-hydrindan)	0.29±0.11	5	50.00
1023-58	$C_{10}H_{22}$	3,3,5-Trimethylheptane	(0.20± 0.15)[3,4]	5	50.00
1024-58	C_5H_{10}	1, cis-2-Dimethyl-cyclopropane	0.13±0.05	5	50.00
1025-58	C_7H_{14}	2-Methyl-1-hexene	0.12±0.08	5	50.00
1026-58	C_7H_{14}	2-Methyl-2-hexene	0.14±0.11	5	50.00

[1] The designation "-58" following the sample number indicates a sample of 5 ml (liquid) sealed "in vacuum" in a special Pyrex glass ampoule with internal "break-off" tip.
[2] Tolerance approximately ±10 per cent.
[3] The purity has been evaluated from measurements of freezing points in accordance with the method and procedure of the American Petroleum Institute Research Project 6, as described in J. Research Natl. Bur. Standards 35, 355 (1945), and Anal. Chem. 20, 410 (1948), unless otherwise noted.
[4] Estimated by analogy with isomers subjected to similar purification.

Sinclair to Increase Wyoming Refinery Output

Sinclair Refining Company is proceeding with additions to the Sinclair, Wyoming refinery, which will permit complete processing of some 6000 bbl of additional crude per day. These additions consist of new equipment that will remove bottlenecks on the crude and vacuum stills, together with the addition of a new air blower to the fluid cracker which will increase its capacity from 9000 to 12,000 bbl per day. It is expected that the new facilities will be completed early in the summer of 1953.

The additional products made by these facilities will include motor and aviation gasoline and distillate fuels. These products will be available for shipment through the new Pioneer Pipe Line system to Salt Lake City and thence through the Salt Lake Pipe Line system into the Pacific Northwest which is an area where these products are now needed for military and industrial installations.

Turkey's First Refinery Set

A contract to build the Turkish nation's first major oil refinery and pipe line at a cost of approximately $8,000,000 has been awarded to The Ralph M. Parsons Company.

Construction will probably begin by mid-year, with completion of certain parts this year and final completion scheduled for late 1954.

It is planned that Turkish operators will be trained in the United States during the pre-construction period. The refinery will be operated under American superivsion during the first year of operation, but will gradually be turned over to an all-Turkish staff as personnel become trained.

This will be Turkey's first refinery. It will have a capacity of 6250 bbl a day, and construction will include 25 miles of pipe line from the newly developed fields.

The refinery will incorporate the latest type Socony-Vacuum thermofor catalytic cracking unit, and will manufacture motor gasoline, kerosine, diesel fuel, jet fuel, fuel oil and asphalt. The fuel oil will be used by the Turkish railroads, while the asphalt will go into the fast-expanding Turkish highway system. The refinery will be located at Batman, some 60 miles east of the ancient city of Diyarbakir, and close to the Raman and Garzan oil fields developed by Turks.

Freeport to Mine Fourth New Sulfur Deposit

Freeport Sulphur Company has announced plans for the development of a new sulfur mine—the company's fourth new sulfur project in two years—at a salt dome deposit in the Louisiana marshland. The dome, known as Chacahoula, is in Lafourche Parish 8 miles southwest of the town of Thibodaux and 60 miles west of New Orleans. Freeport has been conducting an extensive drilling program there since last April.

The area lies in the midst of dense cypress swamps, and the undertaking will involve unusual and costly engineering and construction difficulties, according to Langbourne M. Williams, Jr., president of the company. The size of the mining plant to be built will depend upon the results of further studies of these problems, he said.

IGT Fellowship Program

The Institute of Gas Technology, affiliated with Illinois Institute of Technology, announces the availability of 15 fellowships for 1953, leading to the degrees of master of science in mechanical engineering or chemical engineering, or master of gas technology and doctor of philosophy.

The master of science curricula are additions that will accelerate the fellowship program to enable the earning of a master's degree in about 15 months, instead of the two years still required for the master of gas technology.

Houston Refinery Men Hosts

D. A. Young, manager of Sinclair's refinery at Houston, Texas, was host to representatives from Sinclair's New York office, its East Chicago, Indiana, Marcus Hook, Pennsylvania, and Wellsville, New York, refineries for a three-day symposium recently.

Among the subjects discussed were problems in cost accounting, methods of blending and compounding petroleum products, storage of packaged products and equipment for handling packaged products within the refinery, and oil drum reconditioning costs.

Monsanto Given Patents

Two United States patents pertaining to synthetic organic chemical soil conditioners have been issued to Monsanto Chemical Company, vice president John L. Gillis, announced. The first of these, U. S. Patent No. 2,625,529, pertains to the use of a large and diversified class of synthetic organic polyelectrolytes as soil conditioners, including Monsanto's Krilium soil conditioners.

The other patent, U. S. No. 2,625,471, pertains to plant fertilizing compositions containing plant nutrients and certain synthetic organic polyelectrolytes.

Esso Standard to Build New Distillation Unit

Esso Standard Oil Company has announced plans for a 60,000 bbl-per-day crude distillation unit at its Bayway, (New Jersey) refinery.

This addition to Esso's production facilities will provide a major increase in the crude capacity of the Bayway refinery, largest on the East Coast.

The unit, itself, will be a three-stage plant similar in design to two now under construction by M. W. Kellogg Company for Esso at its Baton Rouge refinery. Engineering is currently underway with actual erection scheduled to start in early summer. Kellogg has been awarded contract for Esso's newest plant.

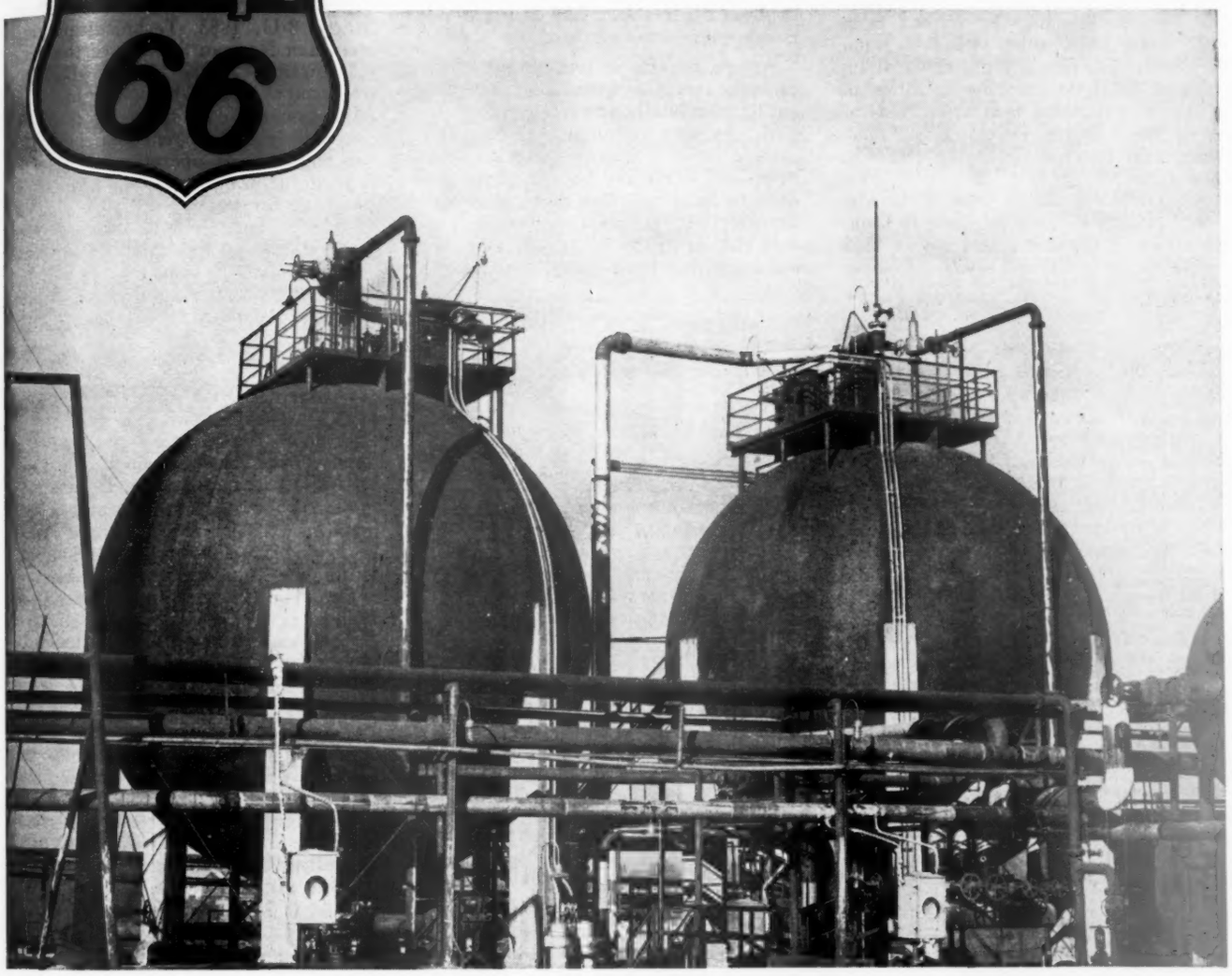
Communications Meet Set

A Symposium on Communications will be one of the outstanding features of a joint meeting in Toronto, April 27-29, of two leading chemical engineering groups. This joint meeting is sponsored by the Chemical Engineering Division of The Chemical Institute of Canada, and the American Institute of Chemical Engineers. It will be the first joint conference of these two groups, and conference officials expect about 700 executives and engineers to attend. Other items on the program will include a series of technical papers, and plant tours to Toronto, Hamilton, and Niagara Falls areas.

Among featured speakers at the meeting will be Robert H. Saunders, chairman of the Hydro Electric Power Commission of Ontario. Saunders' address will be a report on Hydro matters of concern to engineers and executives attending the conference and he will deal in particular with the St. Lawrence Waterway and Power Development.

Phillips 66

another leading refiner who desalts with PETRECO



Phillips Petroleum Company has earned a place of leadership in the oil industry by manufacturing and marketing products of the highest quality. To consistently produce excellent products, a refining organization must possess and utilize a high degree of technological know-how.

One phase of Phillips know-how is their insistence on the absolute minimum of residual salt in the crude charge. Like other leading refiners, Phillips knows that salt in the crude charge, even in nominal tolerances, is a certain trouble-maker. The fact that Phillips utilizes Petreco Electrospheres at Phillips, Texas, to hold the salt content of the crude charge to this refinery to their required low minimum is of considerable significance.

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To obtain more information on products advertised see page E-43

Octane Increases Slight

Overall octane rating changes in the du Pont January, 1953, motor fuel survey were slight, a study of the figures discloses. For premium fuels with one exception the changes were fractional; El Paso premium fuels climbed from 78.7 Motor last October to 82.8 in January, reflecting possibly the effect of increased catalytic cracking facilities in refineries supplying that area. Analogously the research ratings in El Paso rose from 86.0 in October to 90.6 in January.

Generally speaking, less TEL was used in nearly all premium fuels in January than in October, the drop in lead consumption in Casper, Wyoming, being especially notable, from 2.03 cc last July, to 1.71 cc in October, and 1.34 cc in January. While operating (atmospheric) temperatures in that high mountain region explain some of this drop it is probable that increased output of catalytically cracked fuel is the major reason behind the change.

Among regular or housebrand motor fuels the increases were either non-existent or fractionally upward in most locations. As with premium fuels the TEL content trend is downward quite definitely, and doubtless for the same reasons. In many instances the drop in lead consumption, percentage-wise, is considerable as will be seen by study of the accompanying table from the report.

	Octane number, Jan.		Tel content	Octane number, Jan.		Tel content
Premium	Motor	Research	cc/gal	Motor	Research	cc/gal
Aberdeen, South Dakota	82.9	90.0	2.17	79.3	83.3	1.66
Amarillo, Texas	81.2	89.4	2.14	78.5	81.5	2.27
Atlanta, Georgia	82.4	92.5	1.98	80.5	85.3	2.12
Bakersfield, California	84.3	89.2	2.59	76.7	80.6	1.56
Baltimore, Maryland	82.7	92.4	1.98	81.1	86.8	2.03
Boston, Massachusetts	83.1	92.7	2.20	81.0	87.6	1.88
Calgary, Alberta	78.2	86.6	2.47	77.1	81.3	2.28
Casper, Wyoming	80.4	89.0	1.34	76.5	82.2	1.09
Charlotte, North Carolina	82.7	92.5	2.11	80.4	85.3	1.91
Chicago, Illinois	82.4	90.4	1.95	79.4	83.8	1.76
Cincinnati, Ohio	83.4	92.2	2.53	80.5	86.6	1.94
Cleveland, Ohio	83.5	92.8	2.52	80.7	87.4	1.58
Columbus, Ohio	83.4	92.0	2.16	81.4	87.6	1.81
Corpus Christi, Texas	85.2	91.9	2.28	82.3	84.6	2.32
Dallas — Fort Worth, Texas	83.4	92.4	2.09	79.8	84.5	2.30
Denver, Colorado	81.4	89.7	1.54	77.4	81.1	1.47
Detroit, Michigan	83.6	92.3	2.08	80.4	87.0	1.59
Edmonton, Alberta	80.6	87.1	1.72	77.1	82.5	1.15
El Paso, Texas	82.8	90.6	2.74	77.7	81.3	2.00
Great Falls — Billings, Montana	81.2	90.7	1.76	76.6	83.0	1.31
Houston, Texas	83.7	92.1	2.25	80.9	85.2	2.24
Indianapolis, Indiana	82.3	90.0	2.12	79.5	84.0	1.95
Jacksonville, Florida	82.4	92.3	2.06	80.8	85.8	2.07
Kansas City, Missouri	82.7	90.1	1.98	79.6	83.3	1.91
Little Rock, Arkansas	83.6	91.7	1.95	79.5	85.4	1.55
Los Angeles, California	81.8	90.8	2.08	77.2	82.8	1.67
Louisville, Kentucky	83.3	91.8	2.49	80.4	86.1	2.31
Memphis, Tennessee	83.1	91.6	2.46	79.8	85.4	1.92
Milwaukee, Wisconsin	83.0	91.4	2.12	78.6	83.9	1.58
Minneapolis, Minnesota	83.1	89.9	2.31	79.5	83.4	1.79
Montreal, Quebec	81.6	90.3	1.21	79.1	86.3	0.79
Nashville, Tennessee	83.1	91.8	2.23	79.8	85.2	2.13
New Orleans, Louisiana	83.8	91.6	2.30	79.4	85.7	1.85
New York, N. Y. (Metropolitan Area)	82.8	92.2	2.20	81.5	87.0	1.97
Omaha, Nebraska	82.8	89.6	2.18	79.0	82.7	1.40
Philadelphia, Pennsylvania	82.2	92.3	2.08	81.0	87.1	2.19
Pittsburgh, Pennsylvania	82.3	92.1	1.93	80.7	87.3	2.14
St. Louis, Missouri	82.5	90.1	1.93	79.4	83.9	1.74
Salt Lake City, Utah	81.3	87.9	1.05	75.1	79.7	0.43
San Francisco, California	82.0	91.4	1.99	76.8	82.4	1.50
Seattle, Washington	82.1	90.7	2.41	77.4	82.0	1.83
Shreveport, Louisiana	84.9	91.6	2.64	81.0	84.9	2.34
Spokane, Washington	81.3	90.1	1.82	77.8	82.9	1.46
Toronto, Ontario	81.6	90.3	1.85	79.7	86.4	1.86
Tulsa, Oklahoma	83.0	90.2	2.05	79.5	83.1	1.60
Vancouver, British Columbia	82.1	89.0	2.82	80.0	82.7	2.09
Wichita, Kansas	83.1	89.2	2.58	79.5	82.7	1.92
Winnipeg, Manitoba	80.9	88.8	1.41	79.1	84.7	1.14

Thermodynamics Report Out

Basic information on the thermodynamic properties of combustion gases is presented in Bureau of Mines technical report of investigations released by Secretary of the Interior Douglas McKay.

Thermodynamics is a branch of science dealing with the energy content of a substance and the energy changes that take place when the substance forms.

Report is the second of a series giving results of the study for particular fuel-oxidant systems. It evaluates the constant pressure flame temperatures of methane-air and propane-air flames at atmospheric pressure as functions of the mixture ratio and inlet temperature of the fuel-air stream. A free copy of Report of Investigations 4938, "The Thermodynamics of Combustion Gases; Temperatures of Methane-Air and Propane-Air Flames at Atmospheric Pressure," may be obtained from the Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh 13, Pennsylvania.

Alkylation Unit Added To Wyoming Refinery

Standard Oil Company announced plans for a new alkylation unit at its Casper, Wyoming, refinery. Design of the new 700 bbl a day unit is already in final stages.

Construction is expected to begin during the summer of 1953. Completion and initial operation are scheduled for May, 1954.

Other additional new construction will provide tankage and off-site facilities necessary to integrate the new alkylation unit with the existing refinery at Casper. This construction will proceed concurrently with Kellogg's construction of the new refinery unit. M. W. Kellogg is prime contractor for the unit.

AIChE Meeting This Month

Mineral engineering techniques for chemical engineers will be the main feature of the Biloxi, Mississippi, meeting of the American Institute of Chemical Engineers, at the Buena Vista Hotel, March 8-11, 1953. Technical program chairman Norman Spector of the Vitro Corporation of America has planned a program on mineral engineering techniques, with contributions from 31 experts, designed "for teaching the chemical engineer of operations that have heretofore been foreign to him." This program consists of an all day symposium on flotation and a day devoted to panel discussions on fine sizing, sizing devices, sink, and float separation methods and concentrating devices. A program is planned for the ladies.

Davison to Be Producer Of Triple Superphosphate

Early 1954 operation is expected of the $12,410,000 plant for production of triple superphosphate which The Davison Chemical Corporation is constructing at Bartow, Florida, the company announced. It will have an annual capacity of 200,000 tons of the agricultural chemical and according to a recent survey by the Florida Development Commission is the largest among $35,000,000 in construction projects the phosphate rock industry now has under way.

The plant will mark Davison's entry into triple superphosphate production. Total capacity in the industry is estimated currently at 770,000 tons annually. By 1954 Davison's output added to other new and expanded operations will bring the industry's total estimated capacity to more than 1,000,000 tons annually. However, demand by the end of that year is expected to reach 1,600,000 tons, based on forecasts by the United States Department of Agriculture.

Kellogg Book Features Erecting of Refinery

The complex task of erecting a modern refinery is dramatized in a four-color drawing of the job-site featured in the most recent issue of the Kelloggram, just published by The M. W. Kellogg Company. The job is about 75 per cent complete, and the detailed drawings depicts an imaginary 100,000-bbl-per-day refinery and integrated petrochemical plant. It reveals the myriad activities involved in bringing blueprints to reality. It shows welding, radiography, fabricating, guy derricks in action, heat-treating, structural steel work—units on stream—in short, the mammoth job from the ground up.

One section in the Kelloggram deals with the fabrication of a vessel from the time the formed plates are delivered from Kellogg's New Jersey Works to the point where the completed 26-ft diameter, 37-ton section is lifted and then welded into place in a distillation tower. The sequence gives some indication of the painstaking attention to detail required of field forces in just this one phase of putting a refinery together.

PERSONALS

A. Ludlow Clayden, left, has been appointed technical associate in chemical research department of Sun Oil.

John G. Moxey, Jr., succeeds him as manager of automotive laboratory.

A. Ludlow Clayden has been appointed technical associate in Sun Oil Company's chemical research and development department with his assistant, **John G. Moxey, Jr.**, succeeding him as manager of the company's automotive laboratory.

Clayden, a Sun engineer for 30 years, will serve as a staff assistant on problems dealing with automotive matters. An authority on fuels and engines, Mr. Clayden joined Sun in 1922. He became manager of the automotive laboratory at Marcus Hook in 1938.

Moxey, new manager of the automotive laboratory, joined Sun Oil Company in 1935, immediately after his graduation from Swarthmore College, Swarthmore, Pennsylvania. His first job was that of laboratory assistant in the "engine lab" at Sun's Marcus Hook refinery. In 1938, he was transferred to the newly-created automotive laboratory, under the Research and Development department, as a research engineer.

Robert J. Riggs, formerly project engineer for Sunray Oil Corporation at the company's general offices in Tulsa, Oklahoma, has been transferred to the company's Sunray (Duncan), Oklahoma, refinery to be chief refinery engineer. Riggs' transfer to Duncan was effective February 1. He joined Sunray in 1949 as a graduate of the University of Tulsa.

Charles B. Duke has been appointed manager of the refinery supply and distribution division of Sun Oil Company's manufacturing department. He succeeds Donald Lincoln who died recently.

Edwin H. Sampson, Jr., has been appointed assistant manager of the division in charge of supply, and **Wirt R. Robinson** assistant manager in charge of distribution.

Duke joined Sun Oil Company as a yield clerk at the Marcus Hook, Pennsylvania, refinery in 1934. In 1947 he was advanced to special assistant in the refinery supply and distribution division.

Sampson joined the company in 1931 at Marcus Hook, Pennsylvania, refinery in the yield department. He has been a member of the refinery supply and distribution division since 1939.

William G. Domask, Ph.D. in chemical engineering, University of Texas, has been added to the staff at Humble Oil and Refining Company's Baytown, Texas, refinery. Other appointments include: **Harold C. Nix**, Dugway Proving Grounds, and **William A. Burrell**, Buckeye Cotton Oil Company, to technical service division; and **James F. Mathis**, Ph.D. in chemical engineering University of Wisconsin, to research and development division.

W. V. Ischie, formerly operating superintendent of Sinclair's East Chicago refinery, has completed his tour of duty with the Petroleum Administration for Defense and has been appointed assistant to the manager of refineries of Sinclair Refining Company. He will make his headquarters in New York.

During Mr. Ischie's tour of duty with the PAD, he served as director of refining in the foreign division.

Gordon R. Henderson

Jan Oostermeyer

R. C. McCurdy

S. C. Harper

Gordon R. Henderson, Canadian petroleum engineer, has been appointed manager of Sun Oil Company's refinery now under construction at Sarnia, Ontario. Before joining Sun Oil Henderson was vice president and general manager of Catalytic Construction of Canada, Ltd., directing that company's Canadian activities which include the building of Sun's Sarnia refinery. He had been chief engineer of the Polymer Corporation in Sarnia prior to his association with Catalytic Construction.

Henderson was graduated with honors from Queen's University, Kingston, Ontario, in 1925, as a civil engineer.

Jan Oostermeyer, president of Shell Chemical Corporation, has announced his intention to retire May 31 after 36 years of service with various Shell companies. He will be succeeded by **R. C. McCurdy**, now general manager of the Royal Dutch Shell companies in Venezuela.

McCurdy was graduated from Stamford University in 1931, and received his graduate degree in engineer in 1933. In 1939 Oostermeyer became assistant to the president of Shell Chemical, since 1929 a pioneer in the petrochemical field. In 1941 he became vice president, and in 1942 he was named president.

S. C. Harper has been appointed manager of the manufacturing and oil supply department of the Arabian American Oil Company in New York. He succeeds **D. N. Ezzell** who will return to Saudi Arabia. Harper was in the refining department of The Texas Company for 17 years prior to joining Aramco in 1944. After completing two assignments in Saudi Arabia as supervisor of research and development at the Ras Tanura refinery and as staff manager of refining he was made assistant to vice president of technical and supply services in New York, before his elevation to the managership.

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Personals

▸ **R. V. Shankland** has been promoted to senior research associate by Standard Oil Company (Indiana). He has been succeeded as section leader on catalyst research and development by **G. M. Webb.**

In the analytical research division, **H. M. Grubb** has been promoted to section leader, and **C. H. Ehrhardt** and **R. R. Hopkins** to group leaders.

Dr. Shankland joined Standard in 1930 as a chemist. He is a graduate of the University of Michigan. Dr. Webb came to the company in 1948. Dr. Grubb, who joined Standard as a chemist in 1938, is a graduate in physics from Purdue University.

Dr. Ehrhardt joined Standard as a senior project chemist in 1949. He is a graduate of Hillsdale College, and received a doctor's degree in physics from Purdue University. Dr. Hopkins joined the company in 1949. He is a graduate of Ohio State University, and received a Ph.D. in chemistry from Columbia.

▸ **R. V. Becknell** has been appointed manager of the project engineering department of The M. W. Kellogg Company, a subsidiary of Pullman Incorporated, and **O. G. Melchoir** associate manager. Becknell and Melchoir were formerly Kellogg project managers. Becknell will serve as administrative head of the department and in addition will be technically responsible for the project engineering on all company contract work in North, South, and Central America. Melchoir will be technically responsible for activities in Europe.

G. H. Branscombe and **N. W. Lewis**, formerly job engineers, have been named project engineers.

▸ **Dr. Louis H. Goodson,** senior chemist at Midwest Research Institute, has been chosen by the Voice of America to prepare a radio program on chemotherapy in cancer, it has been announced. The program will be beamed at the Far East and European areas.

▸ **John B. Okie,** vice president and director of World Commerce Corporation, has been named a director of Houdry Process Corporation. During World War II, Okie was attached to the American Embassy in Portugal and Spain. In addition, he spent some 12 years in South America and Europe.

▸ **Dr. Richard C. Back** has been appointed to the product development staff of Ethyl Corporation, it is announced. Dr. Back, an entomologist, will serve under Dr. Charles L. Smith, associate director in charge of agricultural chemicals.

▸ **F. W. Kavanagh** has been appointed manager of petroleum products research, development and technical services divisions at the Richmond laboratories of California Research Corporation. He succeeds **A. H. Batchelder,** who was recently elected a vice president of this Standard Oil Company of California subsidiary.

Kavanagh, an engineering graduate of the University of California, joined Standard in 1930.

Gas Transmission Control Problems

Improved instrumentation is resulting in greater accuracy and dependability in compression and dehydration

J. PROCOPI* and W. W. DRAKE*

COMMERCIAL discovery of natural gas in the United States is first recorded in the history of the year 1821. It is amusing to reflect that when this initial commercial well was brought in at Fredonia, New York, the sum total of controls consisted of a large tin barrel — thrown over the well in order to hold the pressure.

In the more than 100 years that have elapsed, continued drilling and exploration have unearthed vast quantities of natural gas, such that today the current proved reserves are estimated to be greater than 200 trillion cubic feet. There can be no doubt that drilling and exploration activities are intensifying yearly, and that natural gas is fast becoming one of the most important sources of energy in the United States.

The problem of transporting this natural gas from its major concentration areas in Texas-Louisiana to industrial and domestic users throughout the country has fostered a boom era in pipe line construction. Many thousands of miles of underground arteries have been built, with perhaps bigger and better ones still to come. Today, long line gas transmission systems alone are handling more than one billion cubic feet of gas every day.

Because efficient gas transmission, as well as cost-correct gas sales and purchases, is closely linked with instrumentation, transmission company engineers and instrument manufacturers are constantly striving to improve accuracy and dependability in the instruments on which so much of gas pipelining depends. Many other less active industries are reaping the rewards of this improved instrumentation, brought about through the ingenuity and ceaseless effort of instrument men in the pipe line industry.

Nature of Control Problem

Control problems in natural gas pipelining confine themselves to two main areas: (1) Gas dehydration and (2) gas compression. There is a tendency to lay toward the use of the so-called "packaged" plant for gas dehydration, where the dehydrator vessels, gas lines, control instruments, control lines, and valves are designed and engineered as a unit, requiring very little more than just connection into the main pipe line.

In like manner, each compressor station along a gas transmission line can be looked upon as a small processing plant, although generally representing a more sizable investment in capital equipment than the dehydration plant. One company is manufacturing a packaged compressor plant, however, mounted on skids and completely self-sufficient.

Compressors and their prime movers, together with water treatment plants, and jacket water cooling, and other cooling systems, present numerous problems in instrumentation, the solutions of which all point toward the goals of (1) automatic operation with all key variables under control, and (2) efficient operation with minimum maintenance and maximum safety of personnel and equipment. These two aims, of course, are also true of the dehydration plant.

Gas Dehydration

All natural gas produced from gas bearing sand is usually saturated with water vapor at the operating pressures and temperatures, necessitating dehydration of the gas prior to its transmission. This elimination of water vapor prevents freezing or the formation of hydrates, which can block the line. At the same time, the dehydration of the gas to a certain prescribed dewpoint will result in a minimum of line and equipment corrosion.

Typical Plant Design. One of the more commonly used dehydration systems is an absorption type that utilizes a solid desiccant. In the particular unit illustrated, operation of the plant is basically cyclic in nature with two towers or contactors being used alternately.

One tower is kept on stream until its bed of solid desiccant is saturated; then it is switched off to be regenerated while the second tower is simultaneously placed on stream. In the switching process, involving 12 on-off type diaphragm motor valves, the need for reliable automatic control to supplant manual operation is paramount. In addition, temperature and flow must be constantly regulated in the system if uniformly dried gas of the proper specifications is to be obtained.

Shown in the accompanying photograph and schematic diagram (Figs. 2 and 3), essential components of the dehydration plant comprise: (1) two contactors ranging in diameter from 2 to 4 ft and in height from 12 to 16½ ft, depending on the plant capacity, (2) a gas-fired heater for regenerating gas, and (3) a regeneration gas cooler where dehydrated gas is heat exchanged with gas from the tower under regeneration. Not shown on the diagram are two additional units of the plant, namely: an

EXCLUSIVE

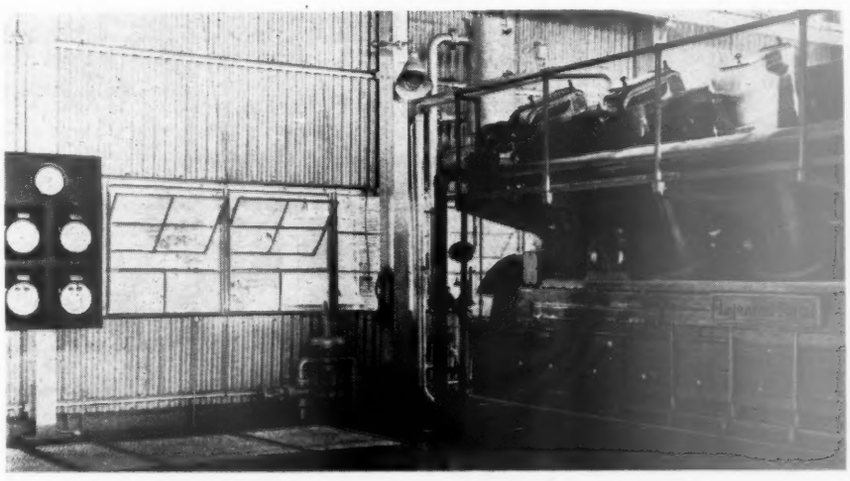


FIG. 1. Recording thermometer, flowmeter, and pressure gage panel mounted near gas compressor.

*Petroleum industry engineers, Minneapolis-Honeywell Regulator Company, Industrial Division.

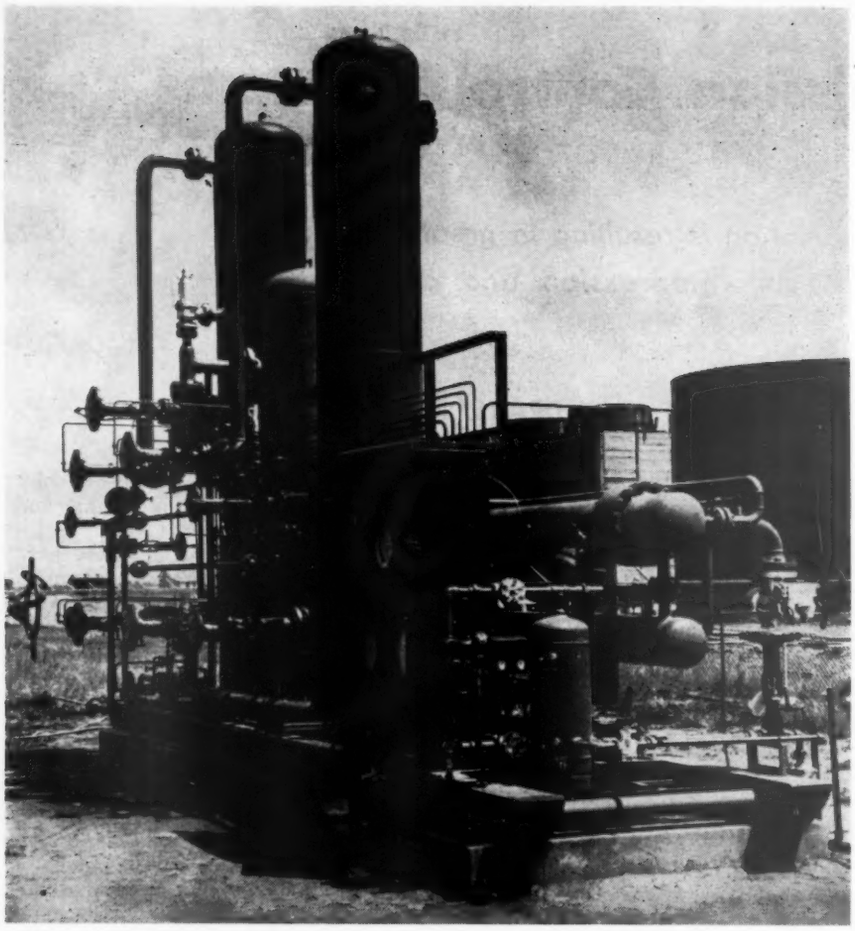


FIG. 2. Package dehydration unit, complete with control cubicle.

inlet separator, which removes oil and entrained solids from the incoming wet gas, and a water separator, which removes moisture accumulating from the regenerating gas.

The process, described in more detail below, basically involves a 16-hr operating cycle, with each contactor on stream for 8 hr, while the other is being regenerated for 4 hr and cooled for 4 stream of natural gas bypassed off the main line wet gas and heated to 350 F prior to its passage through the desiccant bed in the contactor. All equipment is operated under a pressure of 800 psi.

One general feature of the instrument system is its complete independence of outside sources for power. All clocks for chart drives and operation of the time cycle controller are 7-day, spring driven. Control gas for the pneumatic instruments and fuel gas for the heater in the system are supplied from a line tapped off the dehydrated gas line, the pressure being reduced in two stages from 800 psi to 25 psi by means of conventional pressure-reducing valves.

Time Cycle Control. Operating sequence of the on-off type diaphragm motor valves that serve to switch contactors (coded by number-letter combinations on the diagram) is monitored by a time cycle controller through two control manifold systems, as shown. This timer instrument contains two poppet valves operated by cams that are rotated by means of a 7-day spring-driven clock. Connected to the diaphragm motors of two separate three-way valves, output gas pressure from the cycle controller is either applied or bled through

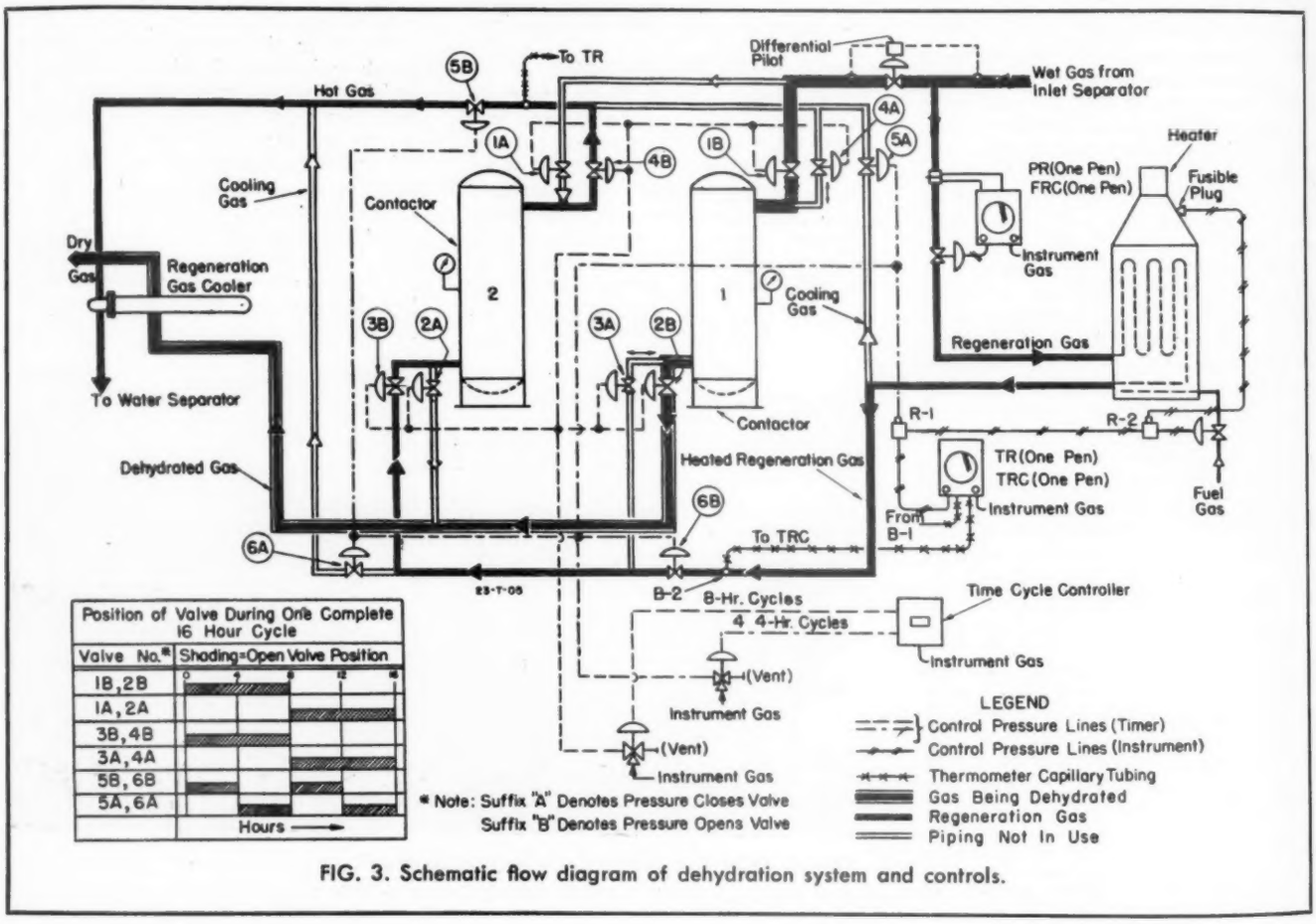


FIG. 3. Schematic flow diagram of dehydration system and controls.

these poppet valves—thereby governing whether full 25 psi gas pressure or zero pressure is maintained in each of the manifold lines to the diaphragm motor valves that switch the contactors.

To follow the cycle of operation in detail, it will be assumed that No. 1 contactor is on stream. Main flow of gas is down through valve 1B, into No. 1 contactor, and out the bottom through valve 2B. Thence, the dehydrated gas flows out of the system, passing through the regeneration gas cooler. This flow continues for 8 hr.

No. 2 contactor is cut off from the main gas stream by valves 1A and 2A, which are closed. To provide heated natural gas for regeneration of this unit, some 10 per cent of the main gas stream is diverted by means of a diaphragm motor valve installed in the main gas stream. This valve is positioned by a "differential pilot" that operates from pressure taps downstream on the main flow line and upstream at the inlet separator; sufficient back pressure is thereby created to provide the bypass flow of gas for regeneration.

Four-Hour Regeneration and Cooling Periods. As shown on the diagram, regenerating gas flow is controlled by a Brown mechanical flow meter (FRC) operating a diaphragm motor valve. The meter also incorporates a pressure spiral and second recording pen for logging the system pressure of about 800 psi. The gas passes through coils in the heater, and then branches into two flow lines, up toward valve 5A and down toward valve 6B. For the first four hours, however, valve 5A is closed, so that flow is only in the lower line through valve 6B, which is open during this same period.

Further, as seen from the chart of valve positions, valve 6A in the lower line is closed, thereby diverting the heated gas up through No. 2 contactor via valve 3B on the bottom inlet line. The latter valve, as well as the valve 4B on the top outlet line of the contactor, is open for the full 8-hr period, and during the first 4 hr permits the flow of heated regenerating gas up through the contactor bed. Moisture laden hot gas passes out through valve 5B, being cooled by heat exchange with dehydrated gas in the regeneration gas cooler, as shown.

During the second half of the 8-hr period, the dried bed of No. 2 contactor is cooled by the flow of unheated regenerating gas, which passes up through valve 5A, down through the contactor via valves 4B and 3B, and thence through valve 6A on out of the system to the gas cooler. This operation is initiated by the time cycle controller, which closes the fuel gas line to the heater, as described below, and cuts off the 25 psi gas supply from one manifold line to reverse the positions of the appropriate diaphragm motor valves (see diagram).

Temperature Control of Regenerating Gas. A mercury-filled Brown thermometer (TR-TRC), range 0 to 500 F, serves to record and control temperature of the regenerating gas, as well as to record on the same chart, temperature of the moisture laden gas leaving the tower. The latter temperature is measured by a stainless steel bulb, B-1, inserted in the common line from the two contactors, as shown on the diagram. As hot gas dries out the desiccant, this bulb serves to record the gradual temperature rise and leveling off when the bed is dry from top to bottom. Thus, it will indicate the drying rate, which can be adjusted by changes in the set point of flow controller FRC.

For temperature control of the regenerating gas, a second bulb, B-2, is situated in the heater outlet line ahead of valve 6B, as shown. A narrow band proportional control unit in the Brown recorder throttles control gas that normally passes directly to the fuel gas control valve through pneumatic relays R-1 and R-2 (Honeywell Type RO48A). In accordance with the temperature set point of TRC, the fuel valve is thus positioned to maintain a constant temperature of regenerating gas.

Pneumatic relay R-1 serves to cut off control gas from TRC and thereby close the fuel gas valve at the end of the 4-hr regeneration period. This is accomplished by connection of the relay pilot in the impulse line from the time cycle controller, as shown. Pneumatic relay R-2 also serves to cut off control gas from TRC through the action of a fusible plug, which is installed to melt at 1100 F to 1125 F, thus venting instrument gas pressure in the event of excessive heater stack temperature.

Gas Compression

In transporting natural gas through pipe lines, initial gas pressure is reduced as a result of line friction. Accordingly, compressor stations situated at strategic points along a pipe line recompress the gas to or near its initial pressure. At these stations, instrumentation is employed to maintain constant pressure on compressor suction and discharge, and to remove any entrained liquid still present in the gas or picked up in the system before it reaches the compressor cylinders. Many safety devices are employed such as pop valves and relief valves. In addition, cooling water control for engine and compressor jackets, as well as other temperature measurements, are utilized in the overall system operation.

Gas Pressure Measurement. Incoming gas pressures are controlled in order to maintain a constant load on the individual compressors. An air-operated controller with proportional band and automatic reset is usually employed in conjunction with a diaphragm motor-operated control element (usually a butterfly valve equipped with positioner).

A two-pen pressure recorder may be employed to log suction and discharge pressures of the compressor. Recent studies in gas pulsation have indicated methods for reducing the unfavorable pulsation factor, but means can also be provided in the instrument to avoid a "paint-brush" effect on the chart record, caused by rapid fluctuation in pressure.

Discharge pressure control can be effected by a pressure recorder-controller, which sets individual engine speed governors by means of diaphragm motors. In operation, the controller adjusts the engine's speed when it is necessary to compensate for variable operating conditions. As close control of discharge pressure is required, the instrument control mechanism usually incorporates automatic reset. Oftentimes, a pneumatic manual operating panel is provided for each engine in order that the speed of any engine may be manually controlled while others are under automatic operation.

Other instruments are utilized on scrubbers, which are installed on suction of compressors and on discharge of each stage. These scrubbers collect any liquid before it reaches the compressor cylinders, and should be equipped with a protective device to prevent damage to the compressors, in case of failure of the liquid removal equipment. In plants that are constantly attended, a high float provides an audible alarm. In unattended stations, a high float can be made to actuate a switch, thus grounding the magnetos and stopping the compressor engine. Other secondary control apparatus usually consists of thermal protective devices on pump bearings, motor bearings, pump-case temperatures, and stuffing boxes.

Jacket Cooling Water Temperature Control. With engine-driven reciprocating compressors, it has been conclusively demonstrated that close control of jacket cooling water temperature reduces maintenance costs. Many mechanical difficulties formerly encountered without such control, such as piston seizure and cracked cylinders, are eliminated with automatic temperature control.

The varieties of open and closed cooling systems employed in compressor stations have resulted in numerous different temperature control systems. In general, however, control is accomplished by varying the amount of jacket water that is cooled, based upon measurement of the water temperature. For such control, a recording thermometer is equipped with a control unit for air (or gas) operation of a diaphragm motor valve. In a closed system, for example, the valve would be on a bypass line around the cooler.

In many of the newer stations, engine lubricating oil temperature is automatically controlled by a recording thermometer, which regulates a control valve on the oil flow through a water-to-oil heat exchanger. In addition, blind pressure controllers are used to actuate alarms, or shut down the engines, when lube oil pressure drops below or exceeds certain preset limits.

One gas transmission company, using a closed system that combines cooling of water for engine oil coolers, engine jackets, and compressor jackets, has employed a Brown ElectroniK controller in a unique fashion for temperature control of the engine and compressor jackets. Extremely fine control is accomplished by using very accurate resistance thermometer bulbs on both the jacket inlet and outlet water lines, the two bulbs being connected so that the *temperature difference* is measured. This company believes that actual temperature difference is most important as

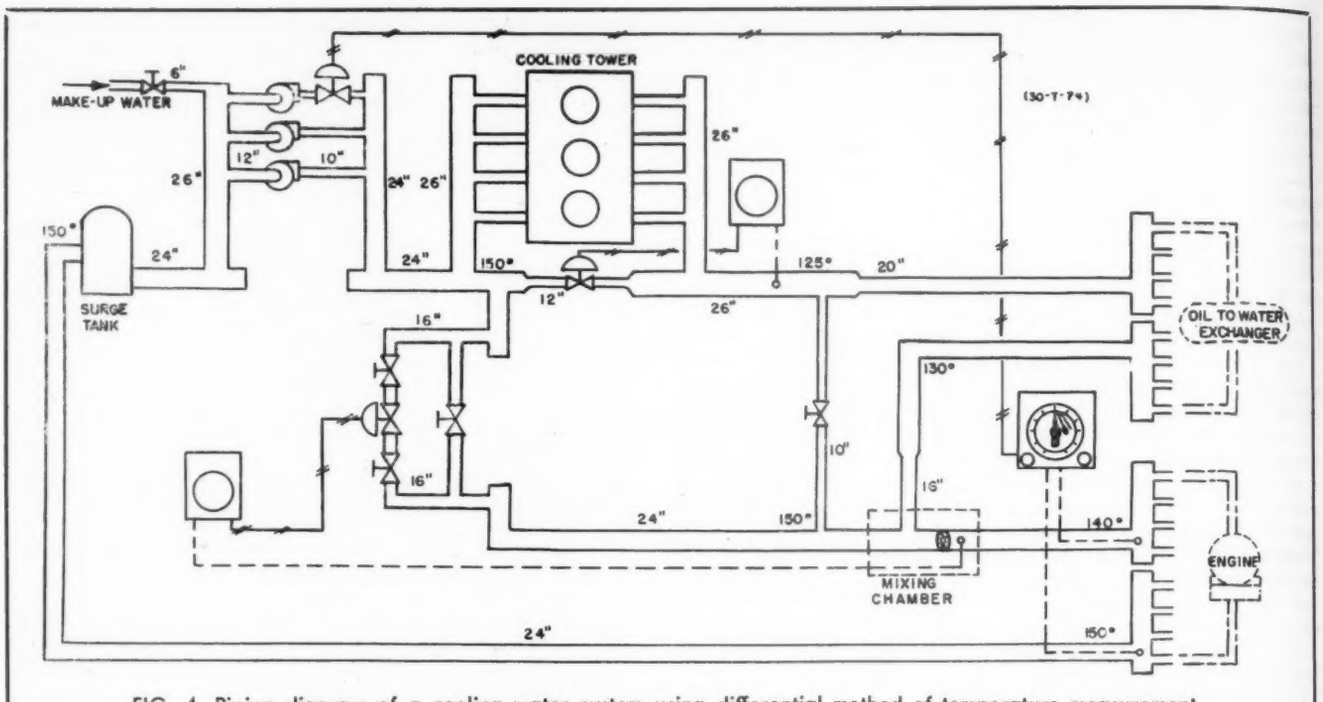


FIG. 4. Piping diagram of a cooling water system using differential method of temperature measurement.

a controlled variable, so that expansion or contraction of metal in the engines is prevented and wear of parts is thereby decreased.

The piping and valving arrangement of this unique system of differential temperature measurement and control is shown in the accompanying diagram (Fig. 4). Beginning at the surge tank and pumps, cooling water is pumped to a 24-in. header where it divides into three parts, one part going to the cooling tower, another through the 12-in. diaphragm motor valve bypassing the cooling tower, and the third part going directly to the 16-in. jump-over and motor-operated butterfly valve. The quantity of water flowing through the cooling tower is therefore governed by three automatically controlled factors: (1) the total capacity of the circulating pumps, (2) the regulation of the 12-in. bypass valve, and (3) the opening of the 16-in. butterfly valve.

These factors, in turn, are regulated by individual temperature controllers. Coarse system control is provided by the 12-in. DMV, actuated by air pressure from a temperature regulator whose sensing bulb is situated in the 26-in. header leaving the cooling tower. Set point on this instrument is approximately 125 F. On a cool day, therefore, the 12-in. bypass would allow more 150-deg water to bypass the cooling tower and proceed to the lube oil coolers.

Less coarse temperature control of the system cooling water is provided by the 16-in. butterfly on the jump-over that connects to the mixing chamber. This chamber contains a 3/16-in. steel plate in which a star-shaped hole has been cut. The purpose of this baffle is to induce turbulence in the water entering from the lube oil coolers and the 16-in. jump-over, and thus insure thorough mixing of these two waters before passing to the engine and compressor jackets. The sensing bulb for the recording temperature controller is placed on the outlet side of the baffle plate. Water from the 16-in. jump-over enters the mixing chamber at 150 F and water from the lube oil coolers enters at approximately 130 F. The set point temperature of the instrument is maintained at 140 F by varying the amount of 150 F water from the jump-over.

To provide very close control of the temperature differential across the engine and compressor jackets, a special differential temperature ElectroniK potentiometer is used, with control set for a 12-deg differential. Reference temperature of the instrument is set at 140 F, which is the nominal temperature of water entering the jackets from the mixing chamber. The 12-deg temperature difference is maintained by first of all having the system stabilized by the 12-in. bypass and 16-in. jump-over, and then by throttling overall pump capacity by varying pressure on the diaphragm motor of the valve in the discharge riser from one of the circulating pumps. In this way, varying the rate of circulation of the water, whose temperature is stabilized, provides very fine control.

In a few of the compressor stations using the differential temperature method of control, the ElectroniK instrument has been equipped with high and low alarm switches set to sound an alarm if the temperature difference goes below or above the predetermined value by about 10 F. For other alarm purposes, a non-indicating pressure controller can be employed to warn of excessive water pressure or lack of water flow in the cooling system.

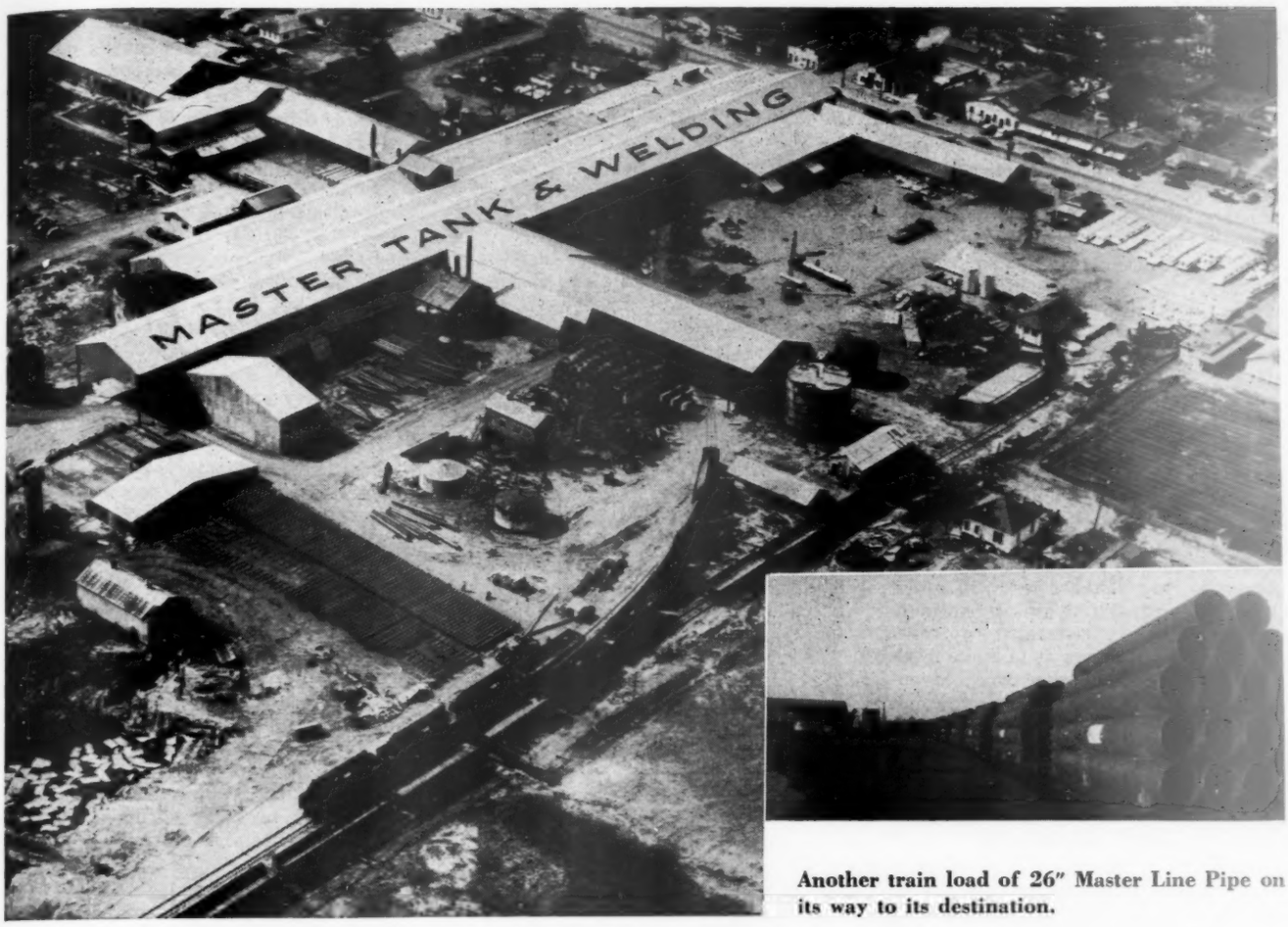
Water Treatment. Where make-up water in the cooling system is to be treated to avoid corrosion of lines and vessels, or to avoid delignification if wooden cooling towers are used, control at the desired pH value can be accomplished automatically with the use of modern electrometric pH instrumentation. A small diaphragm motor valve on the reagent line is pneumatically or electrically positioned to add just the right amount of reagent (usually an acid) to bring the pH to precisely the desired value at all times.

A similar type of recorder adapted for use with a conductivity cell can be employed in the measurement of dissolved solids in the cooling tower water. Operation of the system is simple in comparison to time-consuming manual methods involving the use of casseroles, burrettes, and reagents. The conductivity method, used under recommended conditions, has proved its accuracy because it measures all salts in the tower water —whether due to make-up water, treatment, or added foreign matter. Automatic and continuous blowdown of the cooling tower can also be accomplished with the use of conductivity controllers.

Safeguarding Against Gas Leakage.

A new type of combustible gas analyzer, developed by the Davis Instruments Division of Davis Emergency Equipment Company, employs a Brown ElectroniK recorder to check for leaks of combustible gases in industrial processing. The recorder can be simply equipped with alarm contacts to energize audible or visual alarms. The system operates with a minimum of supervision or maintenance and is ideally suited for use in compressor stations to detect natural gas leaks before gas concentrations build up to a hazardous point.

This system eliminates many of the limitations characteristic of conventional catalytic hot wire filament analyzers, which have inherent zero drifts, especially when exposed to combustible gases over long periods of time. It employs a thermocouple arrangement that provides greatly increased stability, and practically eliminates the zero drift that



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formerly limited the effectiveness of combustible gas analysis systems.

Telemetering

Next in the list of control and supervisory devices for pipe line compressor stations is a system of remote monitoring and control known as telemetering. Designed to maximize the individual station's capability for self regulation, and to increase overall system efficiency, telemetering promises to play a major part in the complete robotization and remote control of tomorrow's natural gas transportation.

In a sense, the term telemetering could be applied to the system of centralized indication and control so prevalent in today's continuous processing operations. This is especially true in large plants, where points of measurement are sometimes a quarter of a mile or more from the control house. As it is generally known, however, telemetering applies to long distance work, in which the signal representing process variable measurement is transformed or transduced in such a maner as to make it acceptable for transmission over conventional means of voice or telegraphic communication.

These means or methods of communication may be company-owned or company-leased telephone lines, power lines, radio links, or the newest and most promising carrier—microwave.

Nature of Microwaves. Microwave is a word coined for those radio waves investigated and developed during the war. They are called microwaves because they are very short waves, some of them less than an inch long. In contrast, the wave length of a standard broadcast station, turned in about the middle of your radio dial, is approximately 300 yd. The wave length of that station is thus comparatively long, and as such has certain advantages and disadvantages. One major disadvantage for telemetering work is the fact that band widths are extremely limited at lower radio frequencies, such as those used in the broadcast band.

Microwaves, on the other hand, act very much like light waves, and are limited to line of sight transmission. Their great advantage lies in the fact that they can be focused by relatively small reflectors, very much in the manner of an automobile headlight beam, and in the focusing, their power is highly concentrated. By way of illustration, a properly beamed microwave, sent out over level terrain at the low power level of 1 watt, will carry as far as a powerful standard broadcast station, scattering its 50.000 w in all directions.

FIG. 5. Water treating pH recorder at work.

Other virtues of microwave are numerous and have appeared in print before. In brief, it can be said that they are a most dependable means of transmission, and as the number and complexity of signals they are required to carry mounts up, they are the least expensive form of carrier. Dependable voice communication is important to the pipeliner, but when the safety of pumping stations depends on unbroken lines of communication carrying control signals, then the dependability of "weatherproof" microwave proves its full worth.

Typical System Operation. A block diagram of a typical telemetering system is shown in an accompanying illustration (Fig. 6). The primary functions illustrated by each block are common to most systems of telemetering and can be described as follows.

First there must be a means of detecting or sensing the process variable under investigation. In the case of temperature, this may be the varying resistance of a resistance thermometer, the expansion or contraction of the spiral of a gas-filled thermal system, or a thermocouple. A pressure sensitive element may be a bourdon tube or a bellows, or any sort of differential pressure device for flow or liquid level. At this starting point in the telemetering chain, the sensing elements are the same as those used in ordinary automatic control systems.

Next in line comes a transducer, a device used to transform the varying resistance, emf, or linear motion of a bellows, for example, into a series of timed pulses, whose durations are proportional to the magnitudes of the measured variables. These timed pulses are actually bursts of audio (low) frequency, produced by an oscillator that is started and stopped at the proportional timed intervals. It is at this point that the break is made from equipment familiar to process instrument men to equipment peculiar to radio communication.

If it were desired to transmit information of only one variable, a multiplexing device (shown in the next block) would not be necessary, as the timed audio bursts could be sent directly to the modulator. The modulator is simply a device used to superimpose the timed pulses on the microwave carrier. One of the great advantages of using a radio carrier method, such as microwave, however, is that a great many different signals can be transmitted on the one carrier. All that is needed is a device to take signals from the various sources, arrange them together in a predetermined order or sequence, and then, after reception, separate them properly into individual channels. As shown on the diagram, the blocks labeled multiplexing stage and channel separator perform these two functions respectively.

The microwave transmitter and receiver are similar in a great many respects to ordinary broadcast transmitters and receivers. They operate at much higher frequencies however, and as stated earlier, the power output of the transmitter is much lower than that of a broadcast band transmitter.

After demodulation, where the timed audio bursts are separated from the carrier, the signal goes to the channel separator. Here the timed pulses corresponding to each variable are separated from the others, and then sent to the receiving transducer. At this point the reverse of what occurred at the start takes place: The audio frequency pulses of timed length are converted into d-c millivoltages that are proportional to the duration of the pulse. Thus the chain of events in the telemetering system is complete. * * *

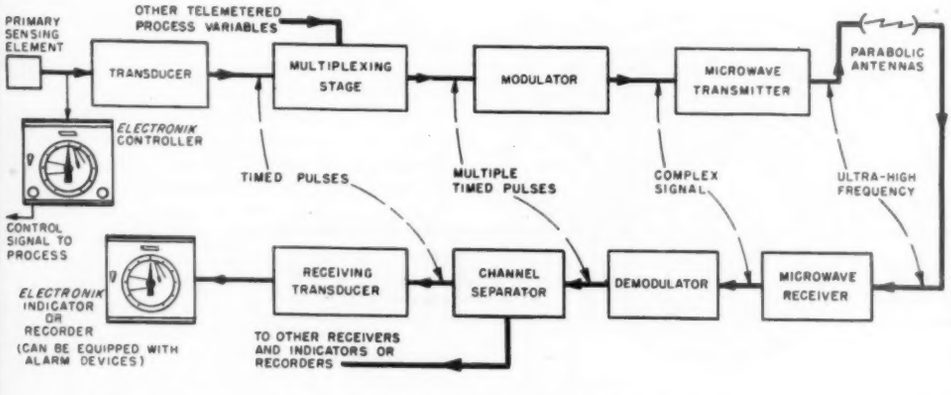
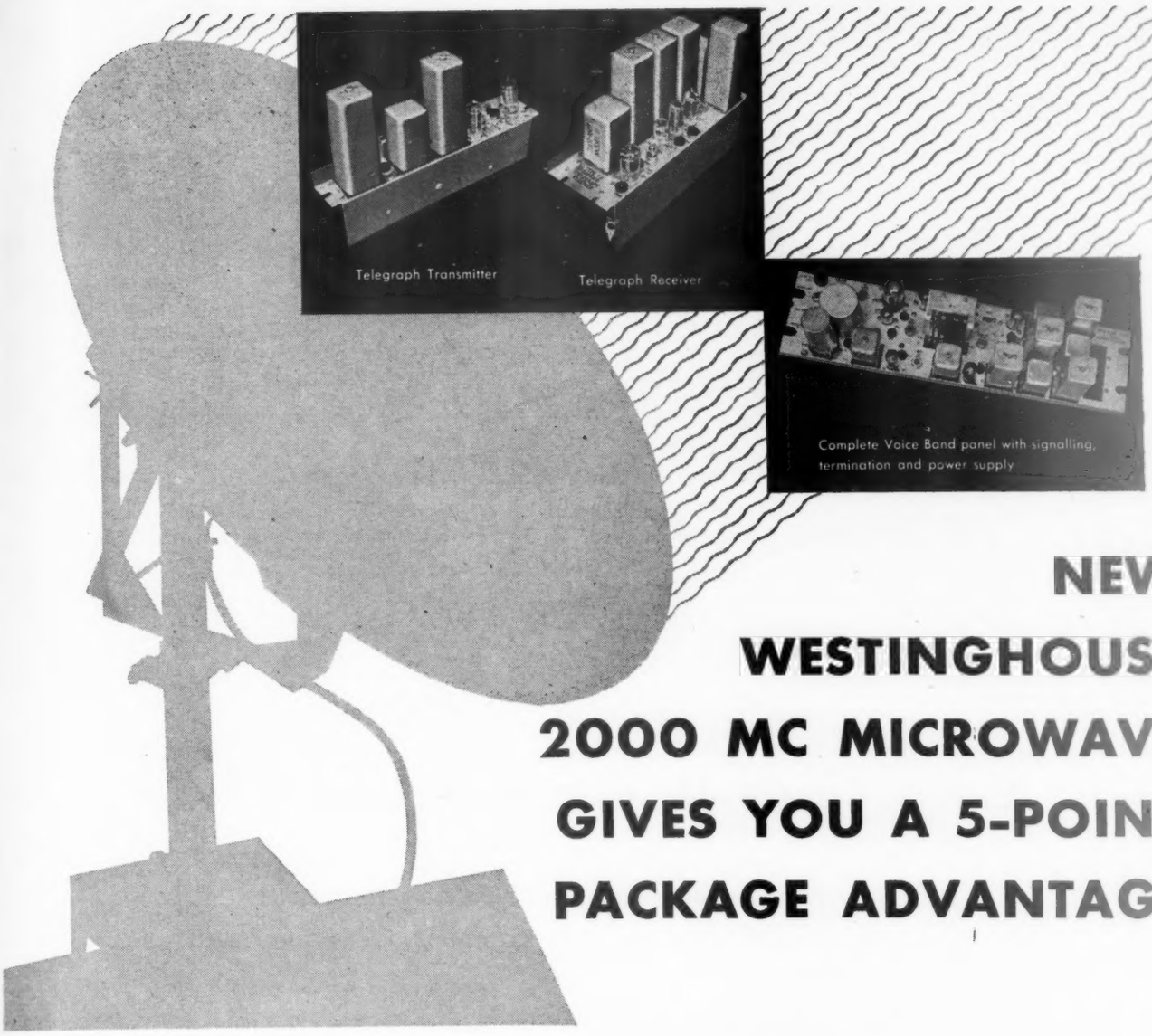


FIG. 6. Schematic diagram of telemetering system.



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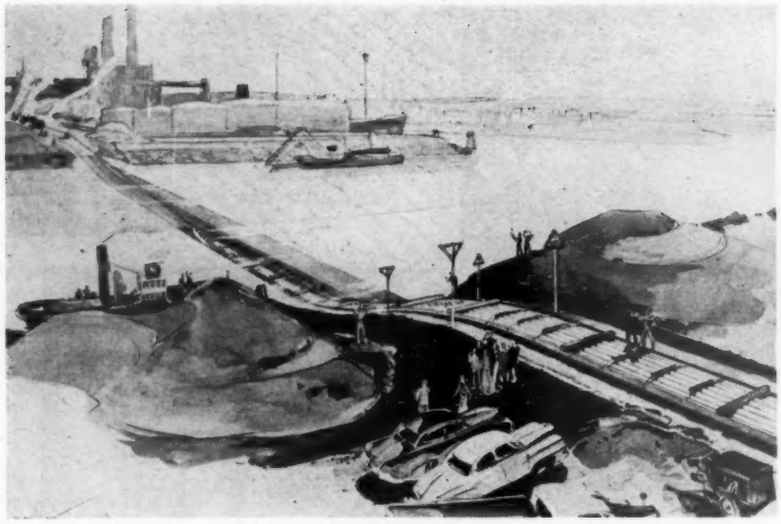


The artist's drawing gives an overall conception of how the pull was made. Succeeding pictures portray details of each step involved.

Tracks over which the pipe lines were to be pulled were laid to the river's edge.

EXCLUSIVE

Eight Lines Under the Elbe River

How crossing was installed connecting the Shell refinery with storage site at Hamburg, Germany

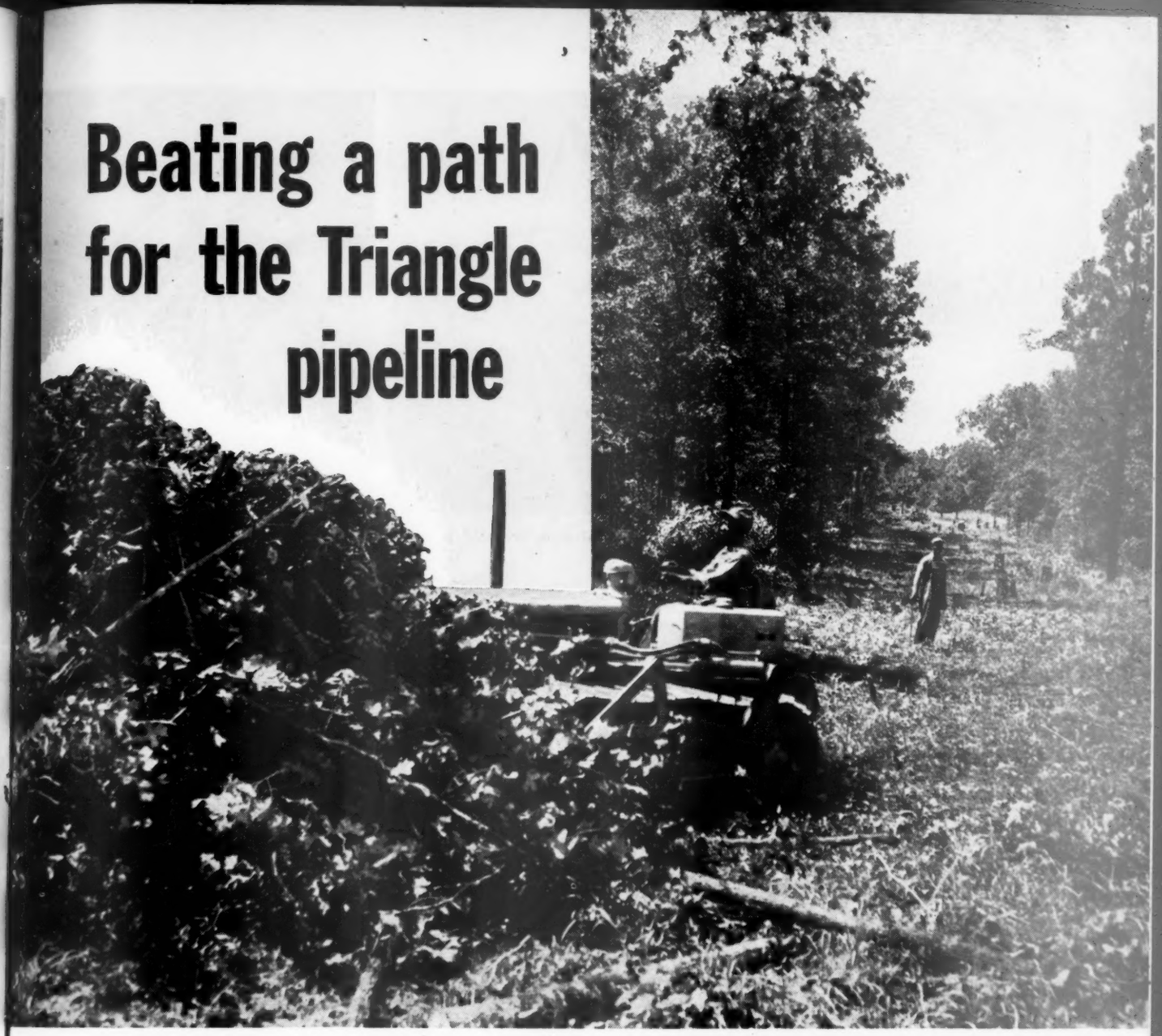
RECENTLY, in the port of Hamburg, Germany, eight parallel pipe lines were laid under the Elbe River to connect the Shell refinery with a newly acquired storage site on the opposite bank. The eight sections of pipe, after being welded on one river bank, were pulled into place by means of three locomotives on the opposite bank. The procedure involved in installing the river crossing is shown in the accompanying photographs and described by the captions.

The tracks were made smooth to minimize friction when pipe lines were towed.

After making the tracks smooth they were protected against rust.

Tin sheets were placed on the tracks and welded together.

Beating a path for the Triangle pipeline



Between Arkansas City and Eldorado, Ark., the Triangle pipeline's right-of-way follows 84 long, tough miles over rolling hills covered with thick brush, swamp and big timber. It took plenty of punch to beat a path through that kind of country. That's why the H. C. Polk Tracting Co. of Prentiss, Miss., called in their Caterpillar Diesel D4 Tractor and Bulldozer team. This husky pair helped clear a 40-ft. right-of-way at the rate of a mile and a half a day over the toughest terrain.

The D4 delivers 43 drawbar HP and 48 belt HP. Its 4-cylinder engine has a maximum drawbar pull of 10,600 lbs. And it idles easily, too—no sputtering because there's no fouling, even with inexpensive non-premium fuels. The D4's rugged final drive has crown shaved gears, mud-proof seals and tapered splines. Its tracks and roller frames are built to last, with diagonal braces that keep tracks in line, yet leave them free to oscillate.

The No. 4S Bulldozer matches the power output of the D4 Diesel Tractor. Its side arms are of tough box section construction; its curved blade is of special high tensile steel. Even the end bits are of alloy steel specially treated for long, tough wear.

The D4 and No. 4S Bulldozer make a powerful, compact unit for right-of-way clearing on any pipeline job. And remember, wherever that pipeline goes, there's a Caterpillar Dealer nearby to furnish the service and the parts that guarantee you the genuine Caterpillar quality that's built into every one of these big yellow machines.

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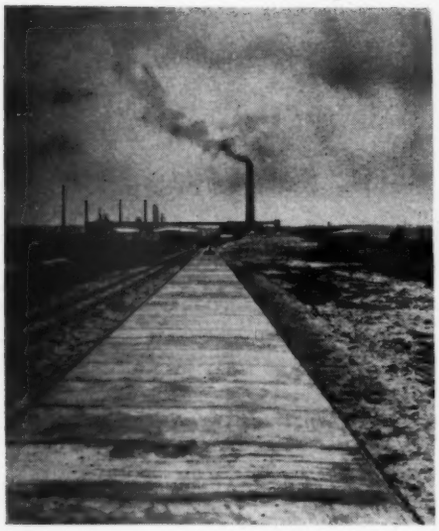
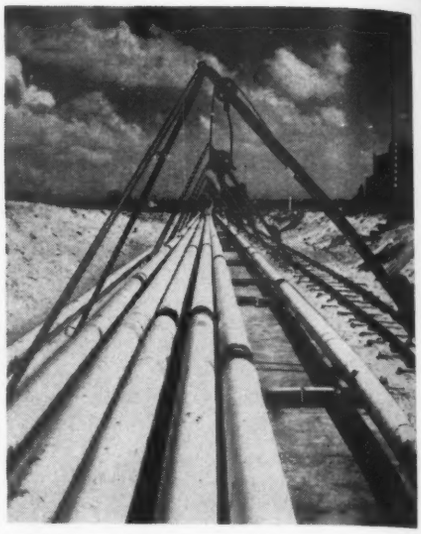


This is the way the tin covering looked when completed and before pipe sections were laid out and welded.

The first joints of pipe are laid out.

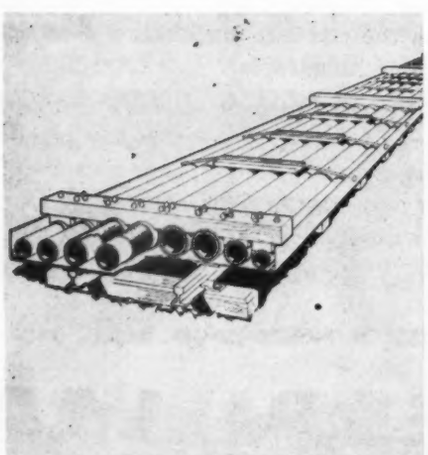


Welding is almost completed on the eight sections of pipe.

As welding progressed, each joint was tested to assure freedom from flaws.

Welded joints were cleaned with brushes before being protected by coating and wrapper.

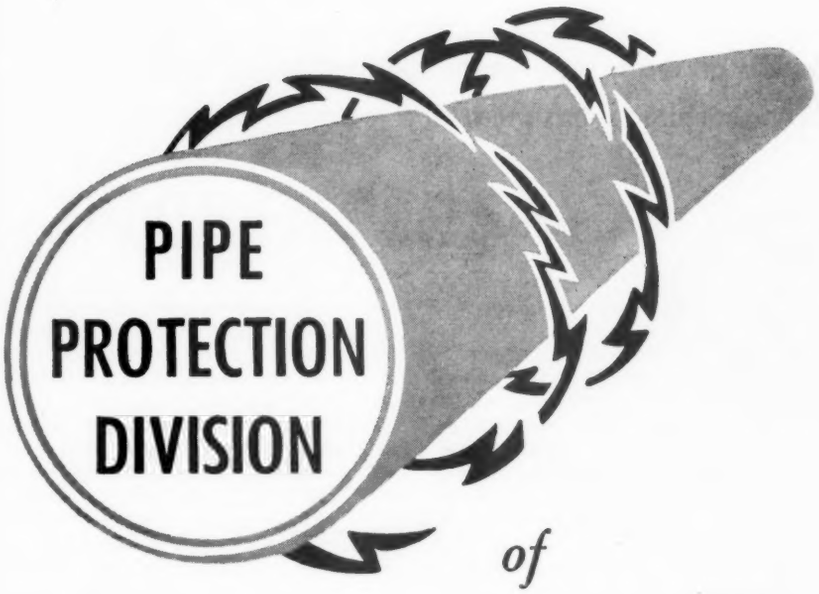
Pipe sections were given a pressure test to assure their tightness.



This cross-sectional drawing shows how the eight pipe strings were laid out on the tin sheets and tied together by means of a wooden yoke. High tin sides further protected the pipe coating.

The front end of the pipe lines was secured to this boat-line vessel, to which a wire line was attached for towing into the river. The pipes here are jacked-up while the track is being greased to make towing easier.

Both banks of the river were cut to give the pipe lines a gentle slope. A clamshell is here making the cut on the side of the river opposite the Shell refinery.



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E-24

P 615.92

Recent Developments in Products Pipe Lines*

A condensation of many new methods and practices developed by operating companies and manufacturers

S. S. SMITH†

In previous years, we have attempted in one way or another to summarize developments and new features of products pipe line technology for reporting to this main pipe line committee. Thus, the preparation of such a paper was usually placed in the hands of a committee, which is always cumbersome and rarely satisfactory. I was recently advised by John W. de Groot that for this year, I was the committee.

After canvassing the various well known operators of products pipe lines, I found so many new developments that the only difficulty in the presentation is to condense it down to a reasonable length while maintaining the significance of developments. At the start, I should like to express a word of appreciation to all the companies who were contacted and who have liberally supplied the best of their knowledge and data on their individual developments, so that the whole industry may benefit from the work each has done. In passing too, I should like to note some of the more interesting facets of these developments. The Plantation Pipe Line and the Great Lakes Pipe Line have devoted the greater part of their development thought to electronics and some of their differences in geography and requirements in their facilities, the Standard Oil Company of California and Sinclair Pipe Line Company have been pre-occupied with methods for determination of interfacial cuts and products specifications. Plantation, Phillips, Standard of California, Sunray, and Shell, each in differing fashions, have been occupied in the development of labor saving devices in automatic stations and remote controls. Pure Oil Company has developed and installed completely new types of hydraulically operated remote valving, which shows promise of having wide usefulness. In their new products line in Ohio, they have improved manifolding by the use of in-the-line vertical pumps to effect shorter interface cuts and reduce construction costs.

The Texas Pipe Line Company is having good success with mechanically cleaned filters, have standardized on tanks with built-in sumps to enable rotation of product in tanks, and are the first users of combinators or totalizers to permit single ticket printing of several pipe line meters.

Other items of importance will be covered in the body of this paper.

In our own Shell shop, we have in various stages of completion new developments in meter calibration practices, products separation methods, and an entirely new approach to the mechanics of pipe line pressure controls. In the following discussion, I shall try to highlight these developments in such fashion that the interested listener may follow up on those items that seem to fit his own operation.

Complex Dispatching Problem

The Great Lakes system, which receives product from numerous refineries scattered over a wide geographic area, has the most complex dispatching problem of any of the major pipe lines. They operate to common specifications of housebrand and premium gasolines from gaged receiving tanks, which are owned and operated by their shipping companies. These receiving tanks are scattered over three states and unless labor means nothing remote gaging is a "must." To meet these problems, Great Lakes has developed remote gages and wire recordings that communicate in voice from magnetic tapes on command, the gaged height in any tank. As the report is a voice report, it can be put on any sort of wire, and the distance from the point of measurement to point of use is important. They make up the units in assemblies so that service and repair is accomplished by unit replacement and specialists at each point are not required. These facilities greatly facilitate putting together their common streams in proper proportions at their line junction points. In their terminals, in order to speed up truck loading in multiple compartment trucks, they have developed electronic counter mechanisms and gang switches so that as many as three products selected at will from any of the rack components can be loaded simultaneously, counted and printed on a single truck loading ticket or manifest in remotely controlled printers at a central point on the truck rack. This description is rather brief but it is apparent that the maximum loading time is thus limited to the time required for the largest compartment. Because these same truck racks also have a wide range of volume requirements, they have arranged their loading pumps in multiple units on each product line to operate in parallel and to be controlled automatically to fit the rack rate requirement. The energizing of their tank valves, the starting of their loading pumps and the signal to the rack that pressure is available, are all handled through a co-axial cable on which a low voltage frequency is impressed to select the sequence operation required, thus one co-axial cable handles the loading from as many as 10 tanks, 30 power units and their associated valves. This system should be applicable and highly desirable in any multiple product tank terminal, to handle the wide ranges of loading rates required to handle one to three or four trucks loading simultaneously.

Following up the information Great Lakes gave us previously about their Missouri River pipe line crossing, they also have developed a satisfactory survey method for exact depth location of pipe lines under river beds, and thus they are able to survey not only the backfill depth over the pipe line but also the pipe line depth under the backfill. This development should be important to all who must contend with silted and scouring river crossings.

Improving Meter Operation

Plantation Pipe Line has a differing dispatching problem from that of Great Lakes since all of their products originate either from terminal or refinery tanks at Baton Rouge. These products, however, are distributed to individual company or batch specification over a 1200-mile system requiring delivery into literally scores of different terminals. They handle their measurement problems entirely by meters and are therefore dependent upon meter accuracies for both dispatching data and line balance and loss figures. In consequence, their developments have been along the line of improving their meter operation, principally through improving the quality of the metered stream. One significant development is their use of new types of self-cleaning strainers. They report extremely good results both from modification of their original hay tank filters and more recent developments in mechanical type filtration, which has self cleaning features by circulating and washing nozzles. They also are having some success in the use of magnetic type filters,

*Presented before American Petroleum Institute, Division of Transportation, Chicago, Illinois, November 11, 1952.

†Manager, Products Pipe Line Department, Shell Oil Company, New York City.

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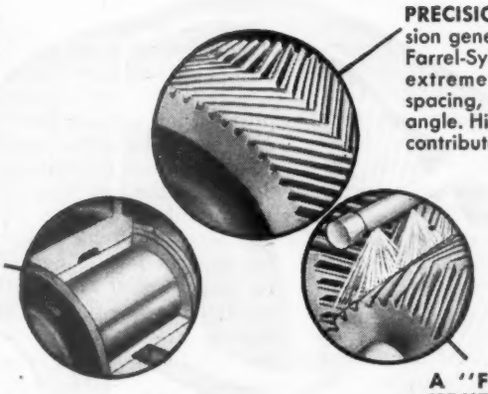

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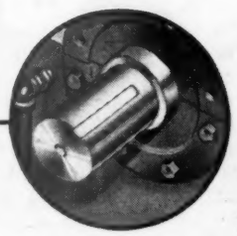

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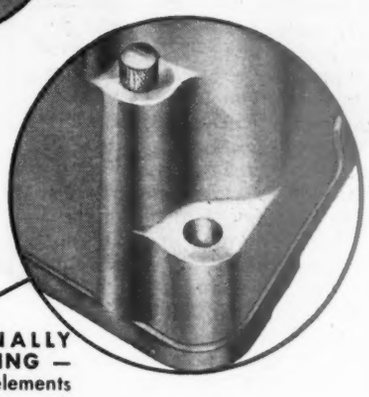

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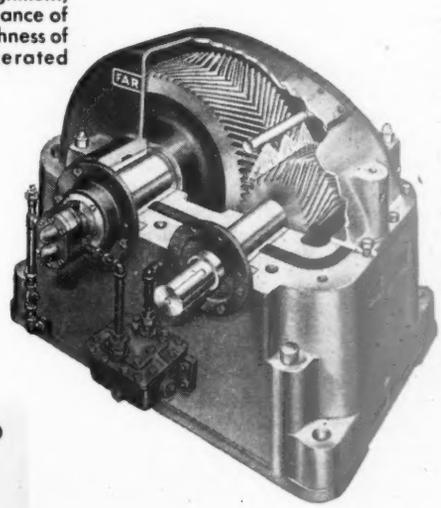

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which selectively hold the iron oxides that move in the line and due to their properties can be removed by magnetic separation. Plantation in the interests of safety and for purposes of accuracy of control have gone over completely to the use of strain gage instruments and electrical impulse transmission into their control rooms and thus eliminate the leakage and maintenance problems imposed by liquid control lines to their control room, with their attendant fire hazards. The cost of such equipment is relatively nominal, replacement can be made easily, and, as all equipment is thus made explosion-proof, one serious source of danger is eliminated. Plantation also has done a great deal of work on mechanical seals and in many cases has seals that under operating pressures of 500-1000 psi have operated 8000-10,000 hr without failure. The use of mechanical seals in pumps designed for their application promises comparatively trouble-free operation and again eliminates the hazards of fluid leakage in pump rooms.

Magnetic Filters

Magnolia, Plantation, and Shell have done development and experimental work on magnetic filters for removal of pipe line scale. Magnolia's and Plantation's work was done with electro magnets, Shell's with permanent Alnico magnets. This would seem to be fruitful ground for further research but its utility may be clouded by the fact that other developments may make the separation of pipe line scale less important for several reasons. Inhibitors and dehydration have decreased scale movement in properly operated products lines to miniscule amounts, and better meters and pump wearing rings are now able to handle the small amounts of scale with little or no damage to equipment. Some of the newer meters use plain sleeve bearings of materials hard enough to handle normal pipe line seals without suffering and we look confidently to the operation of large size meters up to 10-20,000,000 bbl of throughput without repair attention.

Standard of California operates a long line from Utah into Washington State. Conventional methods of handling product interfaces seemed difficult to accomplish on this line and they have developed satisfactory methods of identifying their batch heads by the use of short life radioactive isotopes used as tracers in the product stream. In this development, they have succeeded in making the operation safe for personnel and they report no difficulties either in the handling of material or the accuracy of the results obtained under these methods.

Sinclair and Nelson Electric Company jointly have developed an instrument that measures the dialectric constant of liquids in a pipe line. Readings are instantaneous and can be calibrated so that they correlate fairly closely with gravity of the passing stream. Trans-Northern Pipe Line Company in Canada is installing these instruments for switch cutting, using them instead of the conventional gravitometer. If these instruments will differentiate between two liquids having different compositions but the same gravity, they will be a useful adjunct in cutting between gasolines or oils of closely similar gravity specifications.

Sohio Pipe Line has a small but complex system in the old Ohio Emergency Pipe Line and the Inland system, the latter being a joint operation with Shell. At Sohio's Fostoria station, at the junction of lines from Toledo, Lima, and Akron, they have a difficult problem in matching stream rates, which differ in each of the three lines, all three of which pump in both directions. They found their solution in the installation of two 40,000 bbl tanks, which operate as "put and take" or relay storage. The main physical features are floating roofs, cone and sump bottoms, remote low level alarms, remote precision manometer indexing of the last 6-in. level of liquid, and completely remote gaging of tanks and control of tank booster pumps. All features combine to permit the tanks to be used as float tanks either filling or emptying, put and take storage at full stream rates, and permit complete emptying of tanks so that they may be immediately rotated from one product to another all with minimum requirements for attending labor.

Phillips Petroleum advises that after installation of dehydration equipment on one of their lines, they have been able to completely eliminate the use of scrapers, while, at the same time, their C factors are continuing to improve. They now have one completely automatic and unmanned electric station in which a combination of flow rate determined by positive meter and line pressures are used for control. The operation of this station has encouraged the building of a second one now under construction. Phillips has also rebuilt their old three and four-stage pumps to make them all mechanically sealed and report excellent operation of more than 40 units so equipped.

Texas Pipe Line reports similar progress to that previously credited to Plantation in the use of improved back washed filters for scale removal. Texas, in connection with Smith Meter Company, developed an adding counter or combinator that makes possible the parallel operation of several meters, which combine their registration into one ticket printing head so that one run ticket accounts for the whole stream throughput. With this same equipment, it is also possible to combine two printers so that the same meters can handle the tickets across a flying switch from product to product, tank to tank, or company to company delivery. Texas Pipe Line also has gone over to cone and sump bottom tanks, in their case combining with the pan type roof to give an economic conservation roof that can be rotated from product to product without cleaning.

Standard of Indiana has developed a continuously recording nephelometer to monitor the condition of product stream as it leaves the dehydrating plant. The instrument operates by measuring the amount of light scatter when a beam of light is passed through the flowing sample. As the instrument references to the source light and measures the diminished value of transmitted light, as a proportion of the original light, it is automatically compensated for changes in voltage of the light source. Changes of color of product have negligible effect on the accuracy of the unit, but water droplets or haze do. Thus in Sandard's use of the unit where it is installed downstream from the dehydration plant, it operates to close degree of accuracy. If it be used in a wet stream, perhaps in a line not dehydrated, continuous addition of alcohol to the slip stream to the instrument would be necessary to eliminate the effects of water.

Use of Sealing Scrapers

In the new 14-in. Shell line from Wood River to Chicago, it is necessary to separate some of the more critical specification materials by mechanical means to keep down volume of indisposable mixtures.

We propose to do this by the use of specially designed sealing scrapers, which we have used successfully on an experimental basis in 8-in. and 10-in. lines. The dispatching of these through the intermediate stations where they must be removed and inserted in such a manner as to confine the mixtures that take place in passing through the stations will be automatic. In this operation, the mixtures will be confined between two scrapers and approximately 10 bbl will be added to the mixture at each station. The arrival of the first scraper will operate a mechanical trip and microswitch, which initiates a time sequence and in turn dispatches the front scraper by automatically opening the proper scraper trap valve. The arrival of the second scraper actuates the same trip but in this instance operates a longer time sequence to permit the lengthening of the space between scrapers so as to assure the proper purging of the station before sending out the second scraper. This process is repeated at each primary station where the scrapers are removed and reinserted. On this line, the secondary stations do not have scraper traps and the station when shut down automatically bypasses through check valves in the main line. In these secondary stations, a scraper trip placed ahead of the station will initiate a sequence that first slows the diesel engine down to idle speed and second throttles it to nil throughput so that part of the stream goes through the station and part goes through the check valve that bypasses the station. In this manner, the station will purge itself as the scrapers hang momentarily at the check valve, but again the passage of the scraper past the station will be fully automatic. The 14-in. line itself has been welded over internal lineup clamps using copper shoes so that there are no welding icicles nor lack of concentricity of pipe at the welds to damage the scraper rubbers. Preliminary runs in the line, which is just now going into operation, indicate almost perfect separation of products at the scrapers with no evidence of scraper slippage

in the stream. Using these methods, it is anticipated that the mixture between products will not exceed 60 bbl in a 240-mile 14-in. line and that the mixtures will be accurately confined between two scrapers and thus can be cut into small disposal tanks for reblending or other disposal. In the case of our propane-butane interfaces, the mixtures will be confined to an amount small enough to permit their full utilization as fuel in our own heating boilers at the East Chicago terminal.

In Shell's new 14-in. line, 8-in. meters with a capacity of 3000 bbl per hr each are installed, thus, reducing the usual number of meters. This also reduces the number of calibration runs, but if conventional calibrating tank methods were used because of high meter rates, it would aggravate the disturbance of normal flows while calibrating. Whether meters are on the suction or discharge side of initial station their calibration either causes large reduction of input or requires excessively sized input boosters or main line pumps. In order to avoid these operating difficulties, the calibration of the Shell Wood River pipe line meters is being handled by a radically new method. Using tight scrapers sealed by soft rubber disks, the calibration is a measurement of the liquid required to displace the line through approximately a mile of 14-in. pipe holding about 1000 bbl. This section of pipe is carefully premeasured using piston-packed meters and the measurement of the normal calibration run is automatic after dispatch of the tight scraper. This is done by setting mechanical trips that are triggered by the scrapers to handle switching, electric circuits and solenoid operated clutches at the meters so that a counter is automatically enclutched and declutched to exactly record the gross barrels required to displace the scraper between the two trips. The figure so obtained is then pressure and temperature corrected to net barrels for the factor on the meter. None of the operation interrupts the normal stream or requires moving any product from the line except the fill of the scraper trap at the end of the run. Incidentally, the receiving scraper traps at the end of the measured mile will not only receive scrapers but will automatically dispatch new scrapers when the dual scraper operation is used for product separation so that attendance by operators is not necessary at the time of the scraper passing. All features incorporated in this operation have been thoroughly tested in full scale operation and are known to be sound.

Component Blender

In the construction of Shell's 14-in. line from Wood River to Chicago, there has also been incorporated a component blender at the Wood River refinery. This component blender will receive seven component streams and automatically blend in the line the required proportions of the various run down streams in the refineries to get proper octane, volatility, etc., in specification gasoline. The full component blending operation incorporates the blending of the component streams plus butane plus lead plus dye plus inhibitor. All streams are metered and automatically proportioned through a blender jointly engineered by Shell and Proportioneers. The blender is expected to save all the normal refinery blending losses because no products are blended in tanks, remove all the requirements for manual valving and pumping in the refinery tank farm, and constitute a much safer operation than conventional methods. These features are being incorporated both in the 14-in. line from Wood River to Chicago and the 8-in. line from Wood River to Lima. The calibration of the blend meters will again be accomplished by scraper displacement of a normal component through its blender meter by feeding it through an 800-ft loop of 8-in. pipe laid within the refinery yard with the same scraper trap features used for calibrating the main line meters, but with gang switching of the circuits to operate the clutch on each individual component meter. This permits the calibration of any component blender meter on stream at its normal running rate and without displacement of any component from its proper place in the blended stream. Thus, both product specification and accuracy of measurement are accomplished in one automatic and fool-proof operation. The cost of calibration will be materially reduced and the accuracy of metering should be materially improved.

Safety at Stations

It has been interesting to see that all products pipe line operators seem to be concerned with the same features affecting their operations. Each company in one way or another has improved the

Pioneer Pipe Line Placed in Operation

A petroleum products pipe line running from Sinclair, Wyoming to Salt Lake City has been completed and is now being operated by Pioneer Pipe Line Company, it is announced by J. W. Liddell, president. The new line has a capacity of 12,000 bbl a day.

Pioneer Pipe Line is jointly owned, 65 per cent by Continental Oil Company and 35 per cent by Sinclair Pipe Line Company.

Facilities of the $8,000,000 project consist of a pumping station at Sinclair, 300 miles of 8-inch pipe line, and a 465,000-bbl capacity storage terminal at Salt Lake City. Sinclair Refining Company operates a 25,000-bbl-per-day refinery at Sinclair, Wyoming, the point of origin of all shipments over the line.

In addition to providing increased supplies of petroleum products for the Intermountain area through its Salt Lake City terminal, the Pioneer line will supply products to the Pacific Northwest through transfers to the Salt Lake Pipe Line, which serves the states of Idaho, Oregon and Washington.

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HOT DOPE

Straight from the Kettle

on PIPE PROTECTION

★

By Boyd Mayes

● We landed a job the other day that sort of got us thinking. Half dozen joints of used 2" to be cleaned, coated and wrapped. First, though, we had to straighten the kinks out and bevel the ends. It was pretty much the worse for wear. But it got the same precision workmanship that a hundred miles of big inch would get in our plant. And, we didn't have to bid on this one. It just rolled in. What got us thinking was that some yards that have up "Cleaning — Coating — Wrapping" signs might have thrown this little one back. We've coated, wrapped and reconditioned more than 300 million feet of pipe in our day, and we've never turned down a little trouble job for a customer yet. They're a part of our 25 years of continuous service to the Pipe Line Industry.

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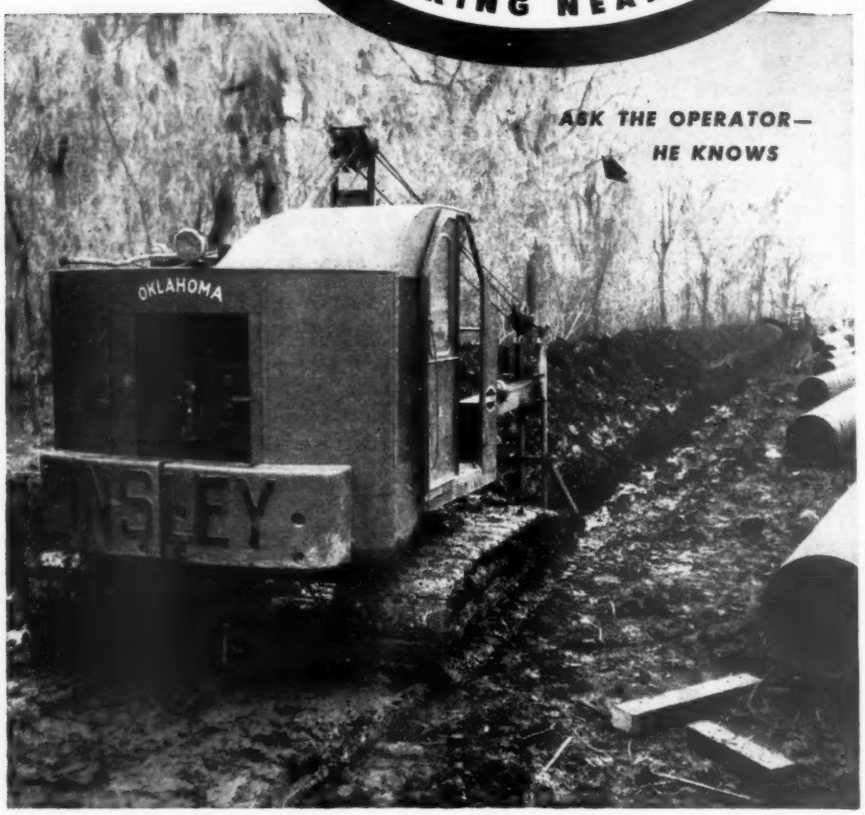

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safety of its stations from the standpoint of fire hazards and protection of control rooms against accident, fire, and explosion. In reality there seem to be two schools of thought as to how to accomplish this particular feature. Plantation has solved the safety features of their control rooms by bringing electrical circuits from strain gages into their control room instead of live product pressure lines. Shell accomplishes the same thing where engines and pump rooms are in the same building with control rooms by bringing only non-inflammable hydraulic fluid into their gage boards. In some instances, Shell has built separate buildings for pump rooms and control rooms and in these instances no products come into the building where switch gear and mechanical apparatus is located. This has been done by the use of telemetering equipment and electrical gaging. In their newer stations, however, the less expensive route of direct force balance control actuated by hydraulic fluids has been used and Shell engineers feel that the greater simplicity of such apparatus together with improved accuracy of control and lower costs make this approach well worth while. Another interesting feature of pipe line design now-a-days is the various methods of eliminating attendants in pipe line stations. Plantation again monitors stations by remote control by microwave installation and incorporates in its system actual control from remote points. Shell did likewise in four intermediate stations on the East Line installed some two years ago, but is now preparing to convert these remote control stations into fully automatic stations, which will in themselves determine when they should or should not operate. In this instance, if the writer of the paper may be pardoned for a personal viewpoint, it is his considered opinion that in the present state of development of automatic control apparatus, it is possible to make remote stations operate more satisfactorily as full automatic stations controlled simply by the pipe line stream than can be accomplished by depending upon either an operator or dispatcher controlling the station from a remote point. This approach was perhaps not sound or even possible a few years ago but with finer control, together with increased reliability on and off station operation can now be accomplished with better reliability and accuracy than can be done with operators on the ground and all the necessary safeguards for protection of equipment and emergency shutdowns on requirement are available in several forms. Thus, in passing, it should be mentioned that Standard of California, Phillips, Shell, Standard of Indiana, Sunray, and perhaps others are all depending upon completely automatic stations, which work either entirely unattended or with minimum caretaker attendants for the purpose of good housekeeping and maintenance. This is a far cry from the multiple unit pump station and manual operation that were conventional a few short years back. Insofar as the writer has been able to learn, no one has yet placed dependence upon complete automatic control of

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product takeoff without supervisory personnel. The writer, however, is conversant with one complete pipe line design not yet built in which four products were to be handled completely automatically from the point of first pumping through all of the intermediate takeoff points and into a final terminal. The intermediate points were to be served by automatic equipment that discriminated between products, and measured the products either on preset volumes or on tank gages in tankage, entirely without personnel present. All the features for such construction are now available, and again, the opinion is hazarded that in the immediately forseeable future either stub lines to remote points or even intermediate terminals on main line systems may be so served.

Most of the power efficiencies seem to be solved. There are available several methods for maintaining the internal smoothness of product pipe lines and C factors are generally maintained on modern pipe lines in the 150-160 C factor range. Standard of Indiana, Phillips, Socony-Vacuum, and others used dehydrated streams and avoid internal corrosion. Plantation, Shell, Southeastern, Pure Oil, Standard of California, Trans-Northern, Great Lakes, and others use water borne nitrite inhibition. Still others, to wit Texas and one or two others, are having success with the use of Santolene C. Still other companies such as Keystone, Susquehanna, and perhaps others have used chromates in one form or another for inhibition of pipe lines.

This paper is no proper place for discussion of external corrosion prevention methods, which has become largely a science in itself and on which whole papers could be written.

This paper would not be complete without a word of tribute to the manufacturers who have contributed so many of the new developments to our industry. I have particularly in mind the meter companies who have steadily improved their measuring equipment to such a point that 10,000,000-bbl runs are not exceptional, to the metals companies who have developed surfaces that successfully stand the abrasion of moving pipe line scale in high speed equipment such as centrifugal pumps, to the various seal manufacturers who have steadily improved their manufacture to the point where several manufacturers' seals in both single and double type are quite satisfactory, to the manufacturers of motors, pumps, and engines who have steadily increased the efficiency and reliability of their equipment to a point where many pipe lines have been unable to justify the installation of standby equipment, to several manufacturers of valves and gates, who have now succeeded in giving us valves that are tight on fuel oil, kerosine, and gasoline, and to a whole list of specialty manufacturers like the various control companies, the manufacturers of servo mechanisms and switch gear who have given us all the component parts required to meet the many and complex problems of control and operation in products pipe lines. * * *

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Rancho is owned by Shell, Sinclair, Pan-American, Crown-Rancho, Nantucket, Phillips and Ashland pipe line companies. Shell Pipe Line Corporation was responsible for construction, started in March of 1952, and now operates the line. A. O. Smith supplied 340 miles of 24-inch welded steel Line Pipe for this project.

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River Crossing Laid as Emergency Measure

Tie-in at Arkansas River made by Magnolia Pipe Line Company with special type of coupling

FRANK H. LOVE*

FOREWARNED by the experience of other companies who had lost pipe line crossings to swift river currents, Magnolia Pipe Line Company during 1952 installed as an emergency measure a second line across the Arkansas River at a point near Little Rock. This was a 5200-ft, 20-in. crude oil carrier. The tie-in with the existing line was made on the north and south sides of the river and in performing the work a special type of coupling was used because of the safety, economic, and time-saving factors involved.[1] In making the tie-in, the couplings were installed over the ends of the pipe joints and tightened by means of set screws, and pumping through the line was resumed even before the couplings were welded. After the pipe was cut the tie-in was made in approximately 30 minutes, and for the entire procedure the time consumed was between three and three and one-half hours, whereas otherwise a 20-in tie-in of this kind would require from eight to nine hours. Full pumping pressure was thus restored within a short period of time, oil loss was minimized, and due to the fact that immediate welding of the joint was not necessary, danger from a flash or explosion was eliminated. The need for packing the line with mud also was eliminated, which, as is well known, can result in severe damage to centrifugal pumps at the first downstream station.

[1]Weld-Ends, manufactured by Pipe Line Development Company.

*Editor, Oil and Gas Pipelining.

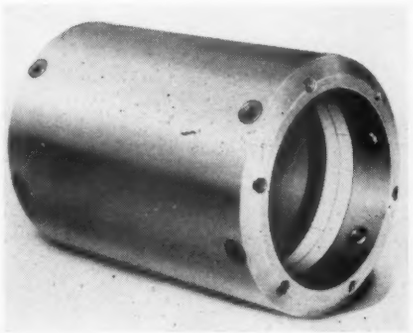

FIG. 1.

In making the installation at the Arkansas River crossing the procedure followed was first to shut the head gates on the main line, then tie a pump on at the low point and transfer the oil from the old to the new line. Displacement of oil was checked by punching holes in the pipe at the place where it was to be cut, and when the line was clear the cut was made with an Alston ratchet cutter, which gave a straight cut and not a bevel. After the coupling was installed the main line gates were opened, the cross-over gates to the new line closed, and full pressure restored to the line.

The several steps necessary in installing the special type of coupling are shown by the accompanying illustrations. Fig. 1 shows the working elements of the coupling. Around the sides are the clamping screws, designed to restrain longitudinal movement of the pipe line due to temperature changes. In the ends are the thrust screws, designed to push against the steel thrust ring, which in turn squeezes against the neoprene packing ring. Compressing the packing ring causes it to flow out between the outer pipe wall and the inner coupling wall to create a pressure-tight seal.

After the cut is made the coupling is slid over the end of one pipe. (Fig. 2). The welder measures and marks off one-half the length of the coupling from the middle of the gap in the two pipe ends. This gap is made wide purposely to save time in lining-up, especially on large diameter pipe. The coupling is now slid back to the mark made on the pipe, thus being divided equally over the joint.

FIG. 2.

FIG. 3.

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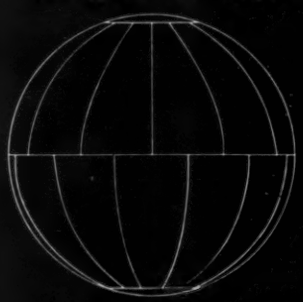

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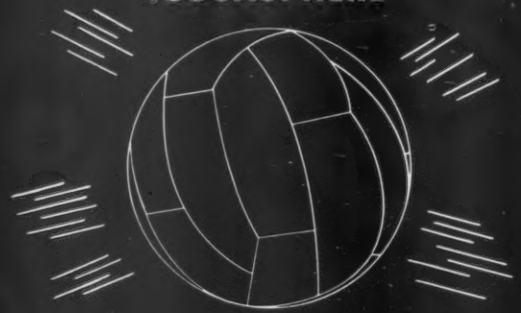

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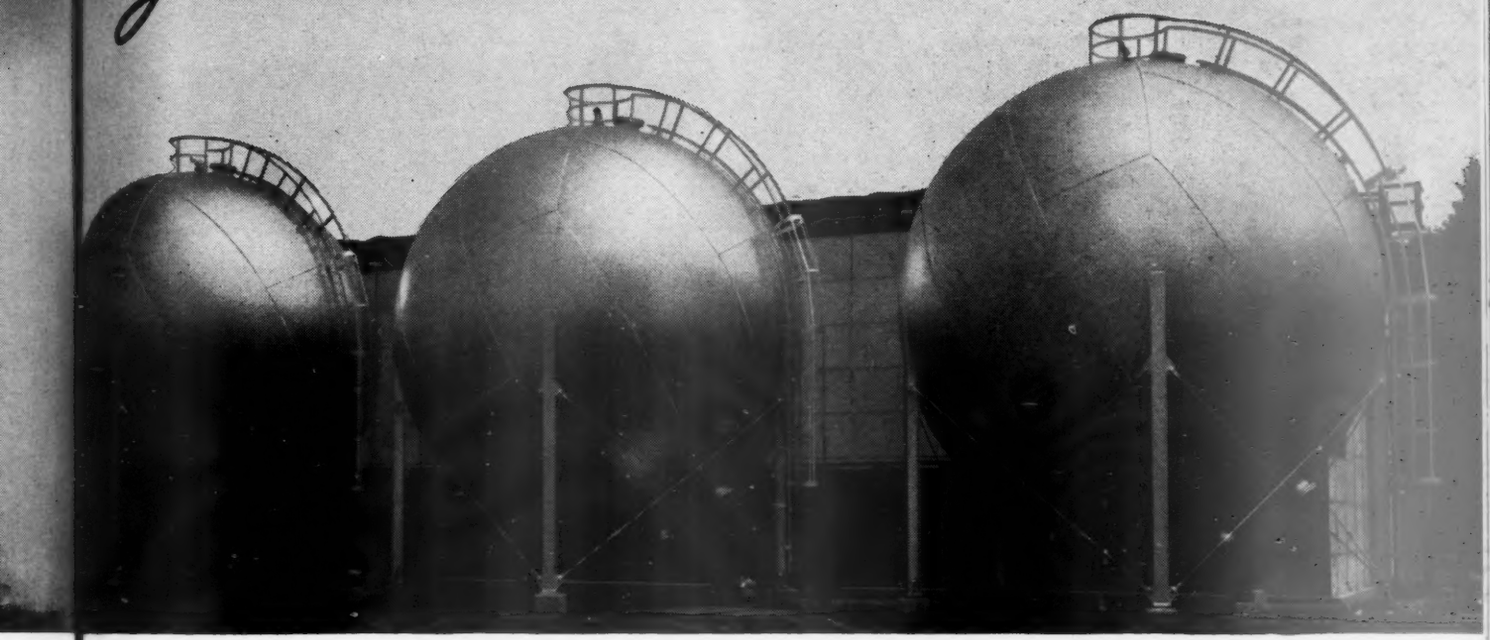

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* The Icosasphere is a sphere made up of plates whose joints lie on the expanded edges of a circumscribed icosahedron.

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XUM

FIG. 4.

FIG. 5.

FIG. 6.

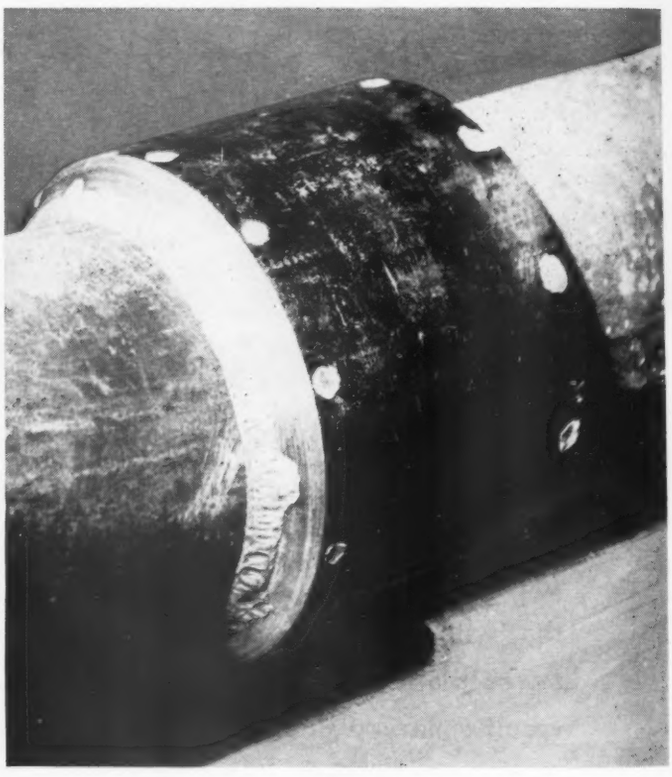

FIG. 7.

In Fig. 3 the clamping screws are being tightened to restrain longitudinal movement of the pipe line. These screws also are used to adjust the clearance between the coupling and the pipe so it will be as nearly equal as possible all the way around. A cheater or pipe lever extension helps to achieve greater tightness of the screws.

The thrust screws are being tightened in Fig. 4. These screws place pressure on the neoprene packing to create a tight seal.

Fig. 5 also shows the tightening of thrust screws, except that here square head screws are being used instead of Allen head screws as in Fig. 4. Square head screws customarily are used on submerged installations. It will be noted that only every other hole is used. Much greater wrenching pressure is possible with the square heads. After the square heads are pulled up tightly, hollow heads may be installed in the alternate spaces, and the square heads backed out and saved for future use. On the Magnolia job, however, the square head screws were cut off even with the coupling and welded. In this manner less weld metal was used, as it was only necessary to run a single bead around the edge insteal of filling, or partly filling, the hole left by a recessed Allen screw.

With the pipe line back in operation, the welder chooses the proper time, when there is no danger of an explosion, and makes his weld. (Fig. 6). In fact, it has been demonstrated that the safest time to weld is with the line full and in flow.

Fig. 7 shows the completed job. * *

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Overall view of yard in which pipe is reconditioned.

and reconditioning for new use, the pipe that has been recovered. Likewise, this gigantic operation employs approximately 250 men and requires a considerable amount of special equipment. The responsibility of the entire project is that of the contractor. The only Sinclair employees on the project are men of long experience who grade the pipe according to company specification and a few inspectors.

Approximately five to six miles of pipe are removed daily and readied for transportation to the yard for reconditioning. Rail facilities being available at these sites permit the loading of rail shipments of reconditioned pipe from the yard, as well as the loading of scrap.

Sequence of Operations

The sequence of operations involves the staking of the lines at intervals, which are situated with the aid of a line finder; cutting of the lines at road intersections, which permits the withdrawal of the carrier pipe from the casing under these road crossings without damage to the roads; cutting the casing to the

Reclaiming Operation Provides Needed Pipe

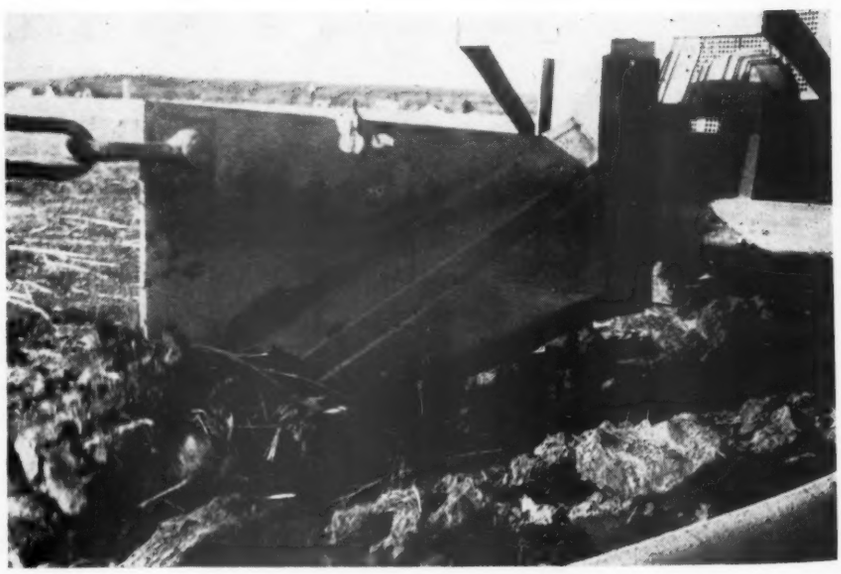
Multiple lines between Drumright, Oklahoma, and Humboldt, Kansas, salvaged by Sinclair

C. F. MACK*

ALTHOUGH the construction of Sinclair Pipe Line Company's new 22-24-in. line between Cushing, Oklahoma, and East Chicago has not reached completion, the company for the last few months, has been utilizing this new line between its Drumright, Oklahoma, and Humboldt, Kansas, pumping stations. By so doing it enabled Sinclair to reclaim its multiple line system of 8, 10, and 12-in. diam pipe between these points, for which there has long been a great demand by the company and the industry.

To accomplish this vast and expensive operation Sinclair awarded a contract to O. R. Burden Construction Corporation, Tulsa, Oklahoma, for the job in its entirety. The contract was divided into two sections between Humboldt and Caney, Kansas, and from Caney to Drumright. Operations began from Humboldt and presently are about complete to the company's Argo pump station at Caney.

Huge storage pipe yards are required for the unloading, cleaning, grading,



The rooter, which breaks the ground and removes all obstructions over the line. A saddle on the front end of the rooter rides atop the line. The lifting cradle is attached to the rear.

*Sinclair Pipe Line Company.

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Bulldozer and rooter. Motive power is provided by this tandem hitch of two 24-ton tractors.

graded elevations of the road bed, and removal of casing from the drainage ditches; and, removal of carrier pipe from road casing.

After these operations are completed the heavy machinery is then moved in over one of the lines and the rooter hooks on and removes the line from its resting place. A cradle attachment at the rear of the rooting machine completely lifts the pipe out of the ground.

Trailing the rooter are two caterpillar tractors with sideboom and cradle attachments, which continue to elevate the suspended pipe and lay it to the side of the open ditch.

The pipe is then cut at collar connections in double lengths about 40 ft long. Double length sections permit more expedient and economical handling.

Trucks follow the cutting crews and the pipe is loaded and brought to the reconditioning yard.

Pipe bending machines straighten any bent pipe before the pipe is placed on line for the cleaning machines.

Automatic cutting and beveling machines then cut off the existing collars, reducing the length of the pipe to regular single lengths.

Brazing machines clean the bevels and ready two joints of pipe for welding.

After final welds are made the pipe is rolled along the racks to the bending machines for straightening and perfect alignment.

At the completion of straightening and alignment of each length of pipe, it is placed in its respective pile according to grade and is ready for shipment. * *

Final operation is the bending machine, which aligns and straightens each length of reconditioned pipe.

Incentive In American Business*

What is the universal incentive that almost completely determines our efforts in life?

JAMES F. LINCOLN

THE greatest resource of any company or organization is its manpower. Yet American business largely overlooks the immense possibilities of developing people's latent abilities. The great opportunity and the challenge that the business leader has is to find out how to give people the opportunity, the challenge, and the incentive that will make them want to rise above the station in which they are now located.

It is well remembered, it seems to me, a generation or a few generations ago most of us came from Europe or some other foreign country. Native Americans are rare. Yet, America is in a position of dominance in the world. Why is this? For one reason and one reason only. In America we have developed the ability to produce more economically, more rapidly than anyone else has ever done. Why is it that we "foreigners" can do that in America while those who stayed at home cannot? It is for one reason and one reason only. The opportunity was here and the lack of opportunity was there.

The Pilgrim Fathers came over here for that reason and that reason only. Here they could have freedom of opportunity, freedom of thought, and they left security to do it. Here they had the opportunity and because of that opportunity, because of the development of that opportunity, we have made the greatest, most forward-looking race of people that have ever lived in the history of the world.

We have always considered that man was born to be a certain person. We have been very slow to accept the fact that man can develop into almost any person that his ambition and opportunity make him. He is a product of his determination and opportunity.

What a man's ability is at any time depends on two things: First, with what abilities he was born, and, second, how much he has developed those abilities. It is obvious that he cannot have abilities if he is not born with them. It is also just as evident that he will never be able to be conscious of abilities with which he was born if he does not develop them from their latent state in which they were at the time of birth. Most latent abilities of most people remain latent. They are then no more useful to anyone than if they had never existed.

The leaders who have shaped the history of the world would never have been leaders had they not developed their latent abilities in the white heat of crisis. That is how leadership is born from its latent state. The point that we usually miss is that millions of incipient leaders, some of whom would have been even greater than those we know, have gone to their graves as unknown because they did not or would not face crises that would develop these latent abilities. Their leadership would have been different from what we have had. History would have been changed by such leadership. Perhaps such a conclusion is difficult to believe at first. Consideration of all the facts involved, however, can lead to no other conclusion.

We cannot believe that the leadership of George Washington would have developed had he not faced the crisis of the American Revolution and the formation of the colonies into a new nation. Washington instead, without this crisis, would have been a very delightful neighbor of the farmers of Virginia.

Just what incentive is it that spurs us to do our best? What is the incentive that brings out our best efforts and develops our latent abilities? In all human experience, there is no better example of an incentive that develops a man's individual abilities and cooperation with others than the incentive in amateur athletics. No one strives harder to increase his skill and output than the amateur athlete. Here is a guide that may answer our search as to what makes a successful incentive.

No one pays an amateur athlete. Hence, his incentive is not money. Short hours are not an incentive either. That athlete will strive continually to win. In fact, if he is taken out of the game so that his hours of work are shortened, he is very unhappy.

Safety is not an incentive. The football player is often injured so that he never recovers the full use of his limbs for the rest of his life. Some players are killed in games or in practice. All could be free from any danger of injury if they so chose. None do. Safe working conditions, therefore, are not an incentive.

Seniority is not an incentive. No one in athletics wants the oldest people to play on the team just because they have been on the squad a long time. The man who starts the game is usually taken out. In fact, the longer he plays in the game, the more apt he is to be taken out.

Security is not an incentive in athletics. No one wants security in a game, neither the players themselves nor the spectators. If a better man comes along, the previous star is out. He wants it that way since he wants to be the one who may oust the star.

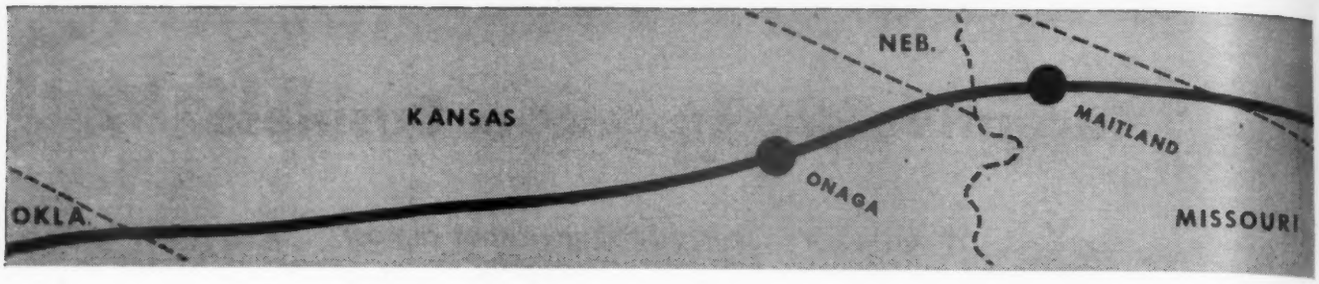
What, then, is the incentive that causes people to strive so mightily for success in an amateur athletic game? The answer is recognition of our abilities by our contemporaries and ourselves. The gaining by our skills of the feeling that we are a man among men. The feeling that we have desirable abilities that others covet. The feeling that we are different in some way or ways that others admire and wish to emulate. The feeling that we are outstanding and are so recognized by our fellows. That is the greatest incentive that is universal. That is the incentive that almost completely determines our efforts in life. *

The Author

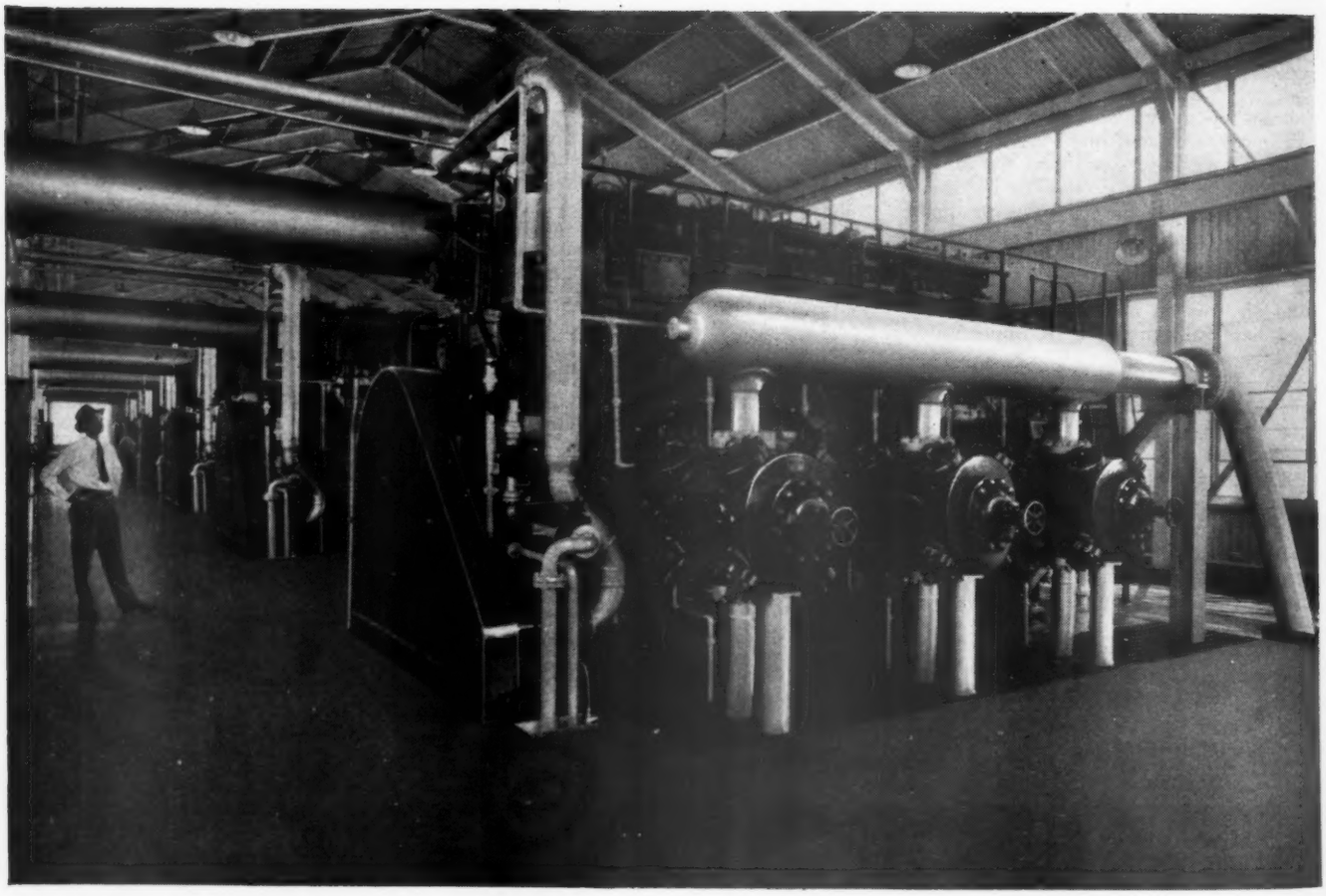
James F. Lincoln is president of The Lincoln Electric Company, Cleveland, Ohio. He was educated at the Ohio State University, joined his brother in The Lincoln Electric Company upon leaving school and began immediately to apply his energy and enthusiasm to the problems of making the developments of electrical engineering, and especially arc welding, useful to the public.

His direction of the company, since 1914, has resulted in the development of an incentive system that has become known throughout the world. He has been an active lecturer on the subject of his philosophy of management and a prolific writer. He is active in the American Institute of Electrcal Engineers, American Welding Society, American Society of Mechanical Engineers and Cleveland Engineering Society.

*Presented before The Pipe Line Contractors Association, Houston, Texas, January 19-21, 1953.



Michigan-Wisconsin Operates 27 Worthington



Six Worthington UTC Engine-Compressors, each rated at 1,400 hp, 320 rpm. Installation is at New Windsor, Illinois, station No. 9 of the Michigan-Wisconsin Pipe Line Company. Each engine uses Worthington's scientifically developed uniflo thru-scavenging system.

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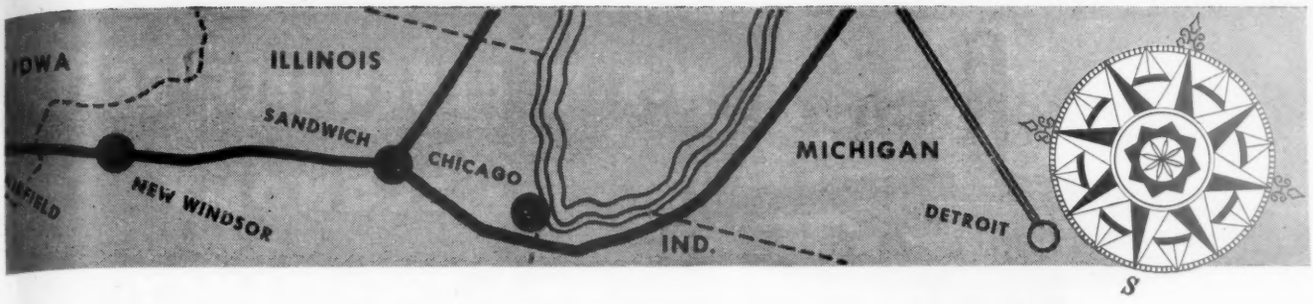

Pipe Line Company Engine-Compressors

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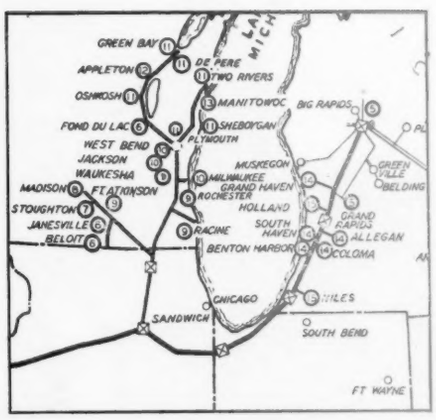

Delivering Gas to Industrial Detroit, the Michigan-Wisconsin Pipe Line Company draws from the Texas Panhandle, with many utilities buying right off the line en route. Operating at its maximum capacity of 343 MMCF per day, this line is one of the few operating at the same capacity throughout the year. A tremendous storage field near Big Rapids, acting as a reservoir for the whole area, takes care of winter demands, absorbs summer pipeline surplus. To keep the gas moving, the pipeline uses Worthington UTC engine-compressors in 3 of its stations. Also used at two other stations are nine Worthington twin-tandem horizontal gas-engine compressors totaling 14,400 hp.

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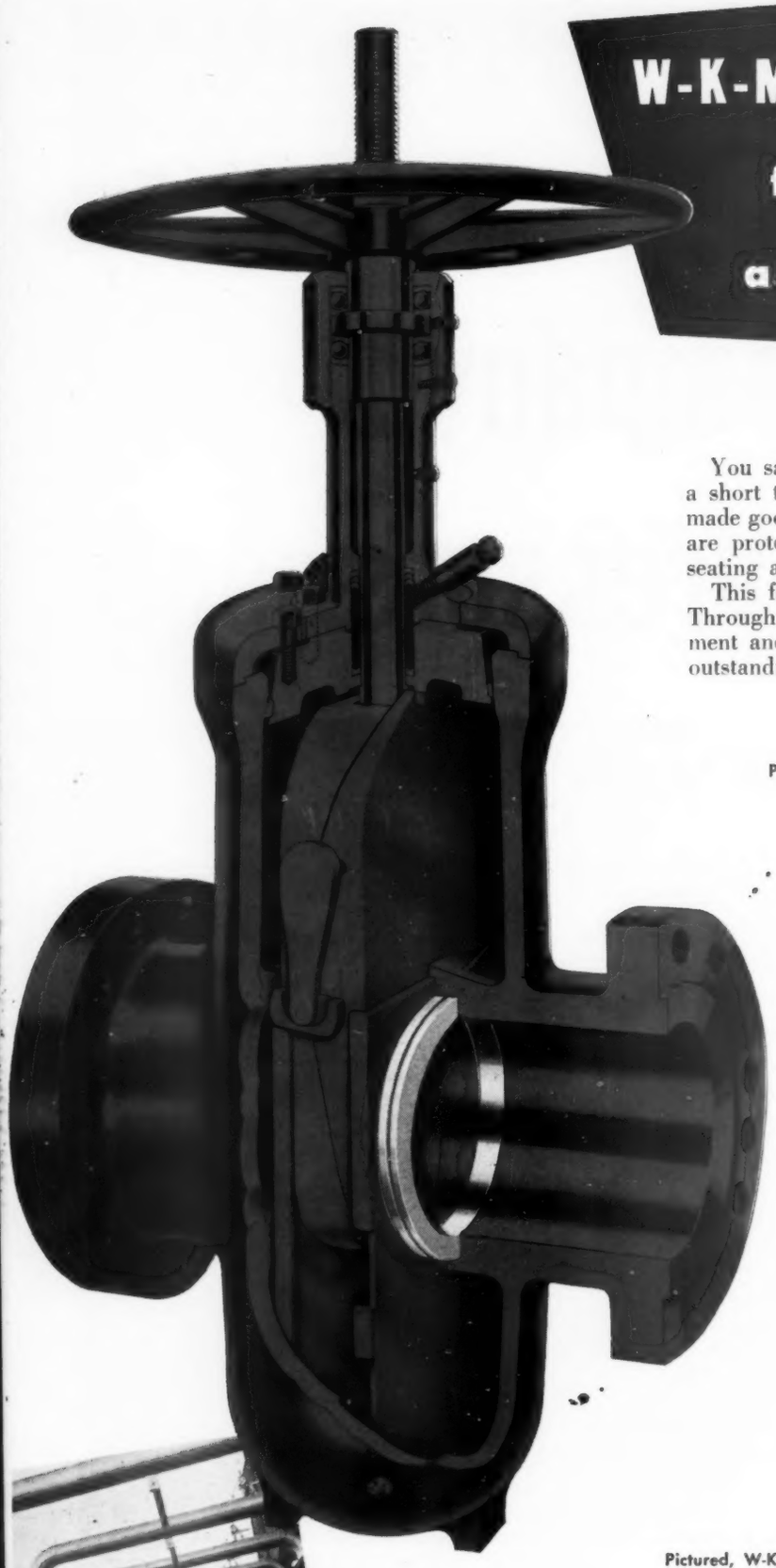

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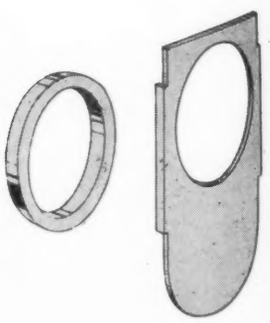
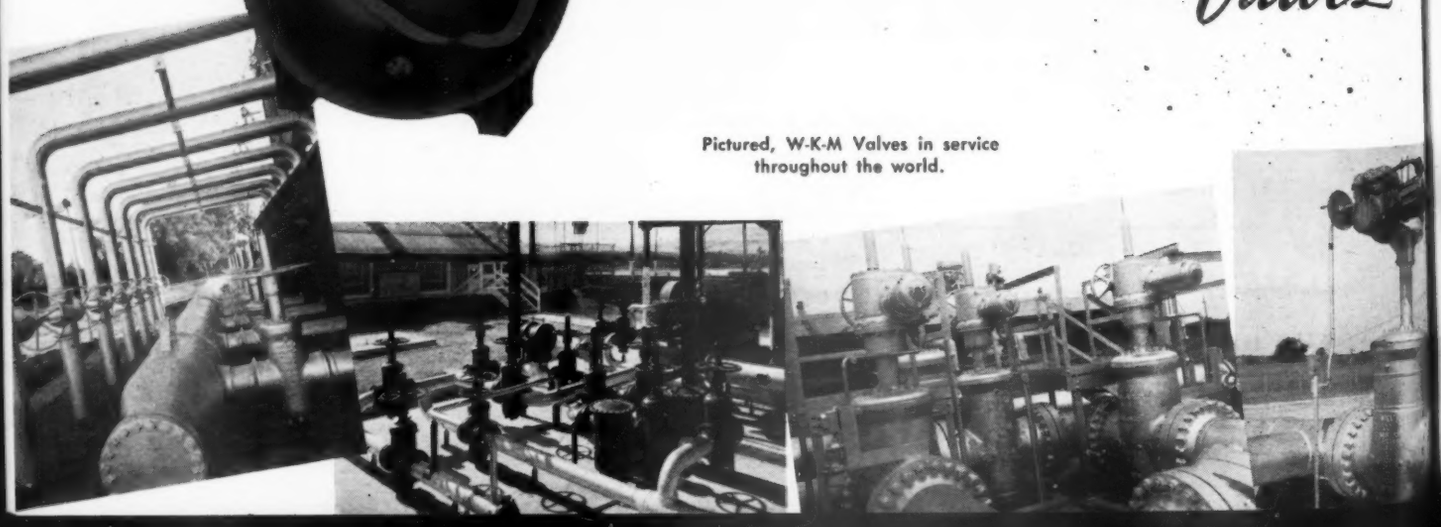


W-K-M Valves

Pictured, W-K-M Valves in service throughout the world.



Welding Specification and the Contractor*

Uniform construction practice, simplified technique result from work of the Joint Welding Committee

R. G. STRONG and A. G. BARKOW†

PIPE LINE welding problems and the topic of a unified welding specification has been the subject of discussion among pipe line contractors and pipe line operators for many years. Numerous suggestions for the development of unified welding requirements were advanced and the subject finally jelled into a real effort at writing such a specification during a public discussion of various interested parties. The initial inception occurred at an unscheduled open meeting during the spring Natural Gas Conference at French Lick, Indiana in May, 1949. The intense interest shown at this meeting prompted further efforts in development of a welding standard.

A general group meeting was next held in Chicago in November, 1949, to which representatives of gas and oil pipe line operators and contractors, as well as various supplier industries, were invited. The principal achievement at this meeting was a resolution requesting both American Petroleum Institute and the American Gas Association to sponsor a joint group to study field welding and related subjects for promulgation of a general specification for all field pipe line welding. This request was granted and the group organized as a formal committee known as the "API-AGA Joint Committee on Oil and Gas Pipe Line Field Welding Practices." At this meeting three subcommittees were appointed, each consisting of four members, representing API, AGA, and PLCA. These subcommittees were instructed to draft independently a model specification for field pipe line welding that would be acceptable to their particular organizations.

The three subcommittees were called to assemble in May, 1950, at Tulsa, Oklahoma, to combine their three separately written specifications. It was remarkable that the three specifications, as written by these various interests, could be summarily combined without great difficulty. Minor points of disagreement were thoroughly discussed and the reasons expounded by the submitting members were examined and reconciled so as to minimize objectionable consequences.

R. G. Strong, director of engineering for The Texas Illinois Natural Gas Pipeline Company.

The combined specification as developed at this subcommittee meeting was circulated to the Joint Welding Committee for comments. Joint Welding Committee meetings were subsequently held in St. Louis, Missouri, in 1951 and 1952 to review and revise the draft in accordance with comments received.

A fourth revision was finally accepted by the Joint Welding Committee for general distribution to the sponsors of this committee. All comments and criticisms received on this draft were reviewed and discussed by the Joint Welding Committee and were incorporated in a fifth revision dated April 1, 1952. This revision was again submitted to the Joint Welding Committee and the various committees of the sponsoring bodies for ballot ratification. This revision was found to be generally acceptable to all committees reviewing it.

For Uniform Construction

The "Specification for Field Welding and Radiograph Inspection of Pipe Lines" is a statement of intent to be used for actual cross-country construction of pipe lines for crude petroleum, petroleum products, and natural gas. The specification was developed to assure uniform construction practice and to simplify the technique with the object of procuring sound and reasonable welding practices. The specification as now written is based on the review of most of the working specifications used by the major pipe line companies of both the oil and gas industries. In addition, the committee has had the assistance of a large number of engineers and contractors familiar with the various problems in pipe line construction and, therefore, believes that this specification is basically sound and can be applied to pipe line construction in all parts of the country and under all field welding conditions. The specifications that we examined in the preparation of this document were written to apply to construction programs in all sections of the country and climatic conditions and the most important contributions of each of these has been carefully considered for inclusion in this specification.

It is noteworthy that in its fourth and fifth revisions it has aroused unusual interest in the entire industry and has been found applicable and desirable for actual construction programs even before it was formally issued by a sponsoring body. Large numbers of copies have been requested both in this country and in several foreign countries where pipe line construction is now or has been in progress. No adverse comments based on these actual field experiences have been received by the committee to date and it is believed that the field application of this specification is invaluable in establishing its authority as a workable procedure. By circulating this specification to its own members and to the members of the subcommittees of the sponsoring bodies, it has been very thoroughly reviewed by leading authorities and has been subjected to approximately 200 letter-ballots, the majority of which have given it unqualified aproval.

The committee has at all times recognized the individual needs and, therefore, has refrained from making definite demands where individual requirements might be desirable and where the intent would not be effected to permit the necessary freedom for particular applications. The committee has also recognized the possibility of subsequent developments that may change pipe line welding technique and has in this respect also made provisions to allow for future expansion so that new techniques may be included as field experience warrants such additions.

Committee Perpetuated

The joint committee has been perpetuated to assure its continued functioning so that now provisions can be reviewed and adopted with the same consideration under which the original spe-

*Presented before The Pipe Line Contractors Association, Houston, Texas, January 19-21, 1953.

†R. G. Strong is chairman and A. G. Barkow secretary of the Joint API-AGA Welding Committee. Paper was presented by Mr. Strong who is director of engineering for the Texas Illinois Natural Gas Pipeline Company.

cification was written. With the adoption of this specification, the pipe line industry can expect a standardization of welding and inspection methods that should greatly improve welding quality and should build a closer relationship between the company and the contractor, leading to a more unified field operation. It was the aim of the committee in writing this specification to cover, in essence, the methods, prime materials, equipment, welding procedures and technique, and radiographic and other inspection practices. The materials recognized are those specified as API Standard 5L Line Pipe and 5LX High Test Line Pipe and weld rod conforming to ASTM-AWS specifications.

The committee particularly prescribed the handling and maintenance of equipment so as to assure proper performance at all times. The handling of materials, particularly weld rod, was prescribed to maintain top quality and reduce waste due to weather or field conditions. As the committee was composed of members of the various interested organizations, all angles in the handling of equipment and materials could be given serious and authoritative consideration to minimize damage without causing undue hardship to any one of the parties because of unsound demands. The specification as written permits reasonable progress in all kinds of terrain and weather conditions.

Although the specification does not require a formal welding procedure qualification record, it very definitely outlines the entire procedure for welding, including requirements for welding bevels, supports, actual welding speeds and practices, number of beads, and other factors necessary for the production of sound welds. Again the specification does not set up a formal welders qualification, but it has prescribed a sufficiently stringent qualification control to prove the professional experience of each welder so tested. The qualification requirements are written in such a manner as to permit the various companies to satisfy their individual requirements without changing the intent of this specification. The committee recognized the fact that certain conditions may impose an adverse hardship on the welder being tested and, therefore, included a clause allowing for a certain amount of retesting, where such retesting appears to be advisable and prudent.

Radiographic Inspection

With the introduction of radiographic inspection and its wide adoption to welding inspection, the committee has given this phase very thorough consideration and in conjunction with several recognized authorities on radiographic inspection, has included a section designed to outline definitely radiographic technique to produce results that will be of best interest to the production of sound welds.

Considerable detail has been included in the specification on radiographic procedure because of the varying conditions encountered in the field. It was felt that with the normal variances of laboratory conditions as affected by field conditions, the procedure of producing radiographs would have to be more closely specified.

It is gratifying to the committee to receive information that the radiographic section has been used by several major contractors in this line of work and has been found applicable in every respect to the radiographic work at hand. It might be stated that considerable recognition has been received on this portion of the specification. The committee on radiographic examination has made every effort to eliminate discriminatory requirements for either X-ray or gamma-ray application, although at times considerable difficulty occurred because of differentials that might lead to discrimination. Such details were worked out in the hope that there would be no serious conflict between these two methods of radiographic inspection and with the reliance that the inspection contractors would produce the highest quality film possible with the equipment used.

The radiographic weld quality standards were developed on basic specifications that have been used in field construction in the past, and with the consideration and on the advice of many experienced engineers in both the gas and oil industries. The requirements for weld quality are felt to be stringent enough to assure sound welding and still not cause unnecessary hardships due to repairs or rejections. By setting the radiographic technique requirements the

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committee felt that the radiographs could be more readily interpreted, eliminating any false interpretations that might cause unnecessary repairs. With clear and precise radiographs all defects can be very definitely identified and no questions will exist as to the nature and size of such defects.

In writing this specification the committee recognized the fact that the owner company and its representatives should at all times hold paramount place in the construction program and every attempt was made to write the specification in such a way that its application would not hinder or remove the authority from the owner company or its representatives.

The committee also recognized the contractors position and believes this specification will be to the best interest of both the contractor and the owner company. The committee further realizes the rapid developments that are taking place in both welding and testing and has given consideration to possible expansion to include such items as automatic welding, preheating, non-destructive testing other than radiography, etc., but felt that at this time none of these items had advanced to a point in cross-country construction where more than recognition could be afforded them. As these items are improved and after sufficient field experience has been gained such items will be further considered for inclusion in the specification.

The specification, being ratified by the regulating authorities of both API and AGA, will be issued in tentative form by the Division of Transportation of the American Petroleum Institute early in 1953.

In concluding this discussion, you as contractors may be considering the question as to what effect this specification will have on your future operation and what benefits you will gain from such a unified specification, if and when it is applied to all field welding of pipe lines. We feel that when this specification is put into use, the contractor and the owner company will have a more basic understanding of what is required and how the proposed work is to be carried out in the field.

You as contractors will also be able to organize your welding on a unified basis in which there will be no minor differentials between the required welding techniques of the various lines to be put into operation and, therefore, you will be able to train your welders in the one acceptable method to produce the best possible welds under all circumstances.

You as contractors will also benefit through his specification in that the inspection, both visual and radiographic, will be unified and will be based on a standard that you yourself have helped to create.

In closing, the committee wishes to express its sincere appreciation to the helpful criticism and sincere cooperation that the various members of the contractors association have given to promote this project and to bring it to a successful conclusion. We sincerely invite the contractors at all times to give us the benefit of their experience so that all future revisions of this specification can be refined to the benefit of the industry in general.

The API-AGA Joint Committee on Oil and Gas Pipe Line Field Welding Practices is composed primarily of four members of each of the American Petroleum Institute, the American Gas Association, the Pipe Line Contractors Association, the National Electric Manufacturers Association, and representatives of pipe manufacturers, as well as individuals associated with related industries.

* * *

Sun Supertanker Makes Record Maiden Voyage

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Records broken for Sun vessel:

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2. Largest single cargo ever delivered to Sun Oil Company's Marcus Hook refinery.
3. Least time per barrel in discharging cargo.

Official time for the 1776-mile trip from Aransas Pass to Overfalls Light in the Delaware River Bay was 4 days, 8 hr and 54 min. Average speed for the trip was 17.88 knots.

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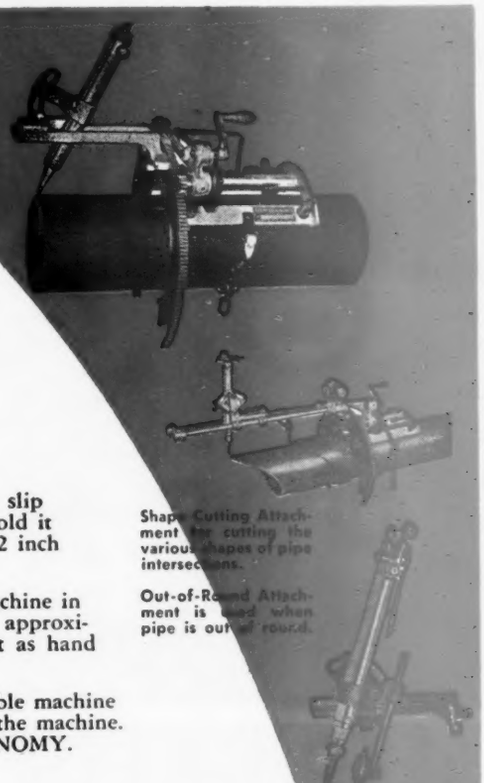

Split horseshoe shaped gear permits machine to slip quickly over pipe. Fast operating snap chain fasteners hold it in place. A complete cut and bevel can be made in a 12 inch pipe in about two minutes.

You'll soon save several times the cost of the machine in labor, gas and transportation charges. H&M takes approximately one-half the labor and gas to make the cut as hand cutting and the work is all done in the field.

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Shape Cutting Attachment for cutting the various shapes of pipe intersections.

Out-of-Round Attachment is used when pipe is out of round.

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PICTORIAL

At the Pipe Line Contractors Convention, Houston, Texas

1. J. T. Cushing, Thew Shovel Company; Wm. McCormick, Jr., Southwestern Equipment Company; F. A. Williamson and C. S. Weber, Thew Shovel; D. E. Ritchie, Ritchie Advertising Agency; J. L. Beltz, Thew Shovel. (Taken at Thew cocktail party.)

2. Seated: Richard A. Gump, executive secretary of the association; Walter H. Davidson, Transcontinental Gas Pipe Line Corporation, one of the speakers, and Robert Thomas, Texas-Louisiana Construction Company, new president of the association. Standing: Bennie G. Pierce of H. C. Price Company; Donald Graham of Associated Pipe Line Contractors, and Carl Lavery of Houston Contracting Company, all members of the panel on safety.

3. R. A. Conyes, president of the association, receives the "Key to The Shamrock" from Managing Director M. Jack Ferrell.

4. Director of association: Back row, Robert D. Sheehan, J. C. Britton, R. H. Fulton, Earl Allen, T. A. Hester, G. A. Manuel and R. P. Gregory. Front row: James P. Neill, Felix Johnson, Robert Thomas, Robert A. Conyes (retiring president), C. C. Bledsoe, W. E. Honey, and Richard A. Gump.

5. Hal Price of H. C. Price Company, introducing James F. Lincoln of Lincoln Electric Company, one of the speakers.

6. R. H. Lyons of R. C. Larkin Company; R. L. Buck of Williams Brothers; A. G. Hobson of R. B. Potashnick; Virgil M. Bull of Missouri Valley Dredging Company, and G. P. Kennedy of Missouri Valley Canadian, Ltd.

7. C. Hobson Dunn of Eastern Pipe Line Contractors; Marvin Thomason and Keith Taylor of Taylor Machinery Company, and Steve Day of S. D. Day Company.

8. Waiting for a session to begin: J. O. "Red" Willett; W. E. Honey of Latex Construction Company of Georgia, and L. H. Favrot of Houston Contracting Company.

9. M. E. Williams, Panama-Williams Company; T. A. Hester, Oklahoma Pipe Line Constructors; "Panama" Shiflett, Panama-Williams Company, and J. C. McKnight, Gulf Coast Oil Field Service.

10. E. W. Lawlor, Pittsburgh Coke and Chemical; R. E. Henry, Pipeline Service Company, and A. E. Gray, Pittsburgh Coke & Chemical.

11. W. H. Law of Oklahoma Pipe Line Constructors and G. H. Osborn of Crutcher-Rolfs-Cummings, Inc.

12. N. K. McFarland and Paul R. Halbert of Lone Star Constructors.

13. J. T. Cushing, Thew Shovel Company; Steve Bechtel, Bechtel Corporation; G. E. Gunther and J. F. Beles, Thew Shovel.

14. B. W. Hoover, Hoover Equipment Company; Felix M. Johnson, Trojan Construction Company, and W. W. Cross, Hoover Equipment Company.

15. J. C. Britton of Britton Brothers.

16. New officers of Pipe Line Contractors Association are; James P. Neill, vice president; Robert Thomas, president, and C. C. Bledsoe, treasurer.

XUM

State Laws and Regulations Affecting Pipe Line Contractors*

Summary of the more important laws of which the contractor must have knowledge

RICHARD A. GUMP†

CONSTRUCTION of cross-country pipe lines, by the very nature and scope of the work, takes the contractor into nearly every state throughout the country, depending upon where the line is to be laid. On one job a contractor may have crews working in several states. It is obvious, therefore, that in addition to a knowledge of the laws and regulations in his home state, he will require information concerning the laws and regulations of other states.

Richard A. Gump

All of you are no doubt familiar with the following clause found in substantially the same language in every contract: "Contractor shall abide by all applicable laws, federal, state, or any subdivisions thereof, and rules and regulations of any other regulatory body in connection with any and all work to be performed hereunder. Contractor shall secure at his expense all necessary permits and licenses for the operation, hauling and transporting of his equipment."

Time does not permit any detailed analysis at this time of these laws and regulations in each of the 48 states. Furthermore, any attempt that I might make to cite the laws and regulations in each state would only serve at most to confuse you and at the very least to bore you. It is, therefore, the purpose of this presentation to call to your attention and summarize some of the more important laws and regulations that may be encountered.

With this in mind, I shall briefly discuss the matters indicated under the following headings:

1. Labor-management relations.
2. Contractors licenses.
3. Income taxes.
4. Property taxes.
5. Sales, use, and gross receipts taxes.

Labor-Management Relations

The law applicable in the field of labor relations ranges all the way from municipal ordinances, through integrated and comprehensive labor relations statutes, to the Federal Constitution; the common law is applicable as well as statutory law; administrative action, such as the rules and regulations of the National Labor Relations Board, is often highly relevant; and the statutory provisions for mediation, conciliation and arbitration of labor disputes are significant elements in the law.

Application of the National Labor Relations Act to a particular case is determined by whether or not a labor dispute, if one should occur, would tend to burden, obstruct or in general affect interstate commerce. If it would, then the statute applies and the National Labor Relations Board has authority to act in the case. In most instances one may assume that the construction of a cross-country pipe line will effect interstate commerce and consequently any labor dispute would come within the jurisdiction of the National Labor Relations Board. Often the operation of state labor relations statutes intersects that of the National Labor Relations Act; both may conceivably be applied to the same business, the National Act because the operations affect interstate commerce and the state act because it happens to be located within the state.

The United States Supreme Court has held that the state acts covering questions not dealt with by the National Act may be applied to interstate business, but where the state act's operation is inconsistent with that of the National Act, the state act cannot be applied in an industry over which the NLRB has generally asserted its own jurisdiction.

States have passed statutes regulating not only the use of labor techniques, but also the objectives of labor organizations. Thus a number of states have passed statutes prohibiting all forms of compulsory unionisms. These statutes gain additional importance in view of the fact that under the Taft-Hartley Act, which is an amendment to the National Labor Relations Act, such statutes are expressly made to have control over even interstate businesses that happen to be within the state.

Before going further, I might digress from the general discussion at this point to give you a roundup of the proposed Taft-Hartley amendments. Under a Democratic controlled Senate and House, Senator Taft had offered a number of constructive amendments intended to correct some of the objectionable features complained of by organized labor and some employers. The naming of Martin P. Durkin as Secretary of Labor indicates that the new administration will take a middle of the road position and Mr. Durkin himself has indicated that the A. F. of L. is ready to change from a policy of "Repeal or nothing" to a desire for constructive amendments. Among the amendments proposed by Senator Taft last session was a bill that in its original draft proposed to keep intact the protection of the original act's language against discrimination in hire, but at the same time would afford the union shop employers in the construction industry, who had settled the question of representation by the union, the same freedom of operations that the manufacturing plant has with its relative steady employment of the same crew year after year. Such relief was sought by such unionized operations because in construction, crews are assembled and discharged at numerous times during a given year and at each time, the hazards of discrimination charges arise. That bill was never passed. It would now appear that if the Congress, under Taft's leadership, and organized labor are both willing, it will be the first time since the hearings on the original Taft-Hartley Act in 1947, that genuine constructive efforts could be put forth to make the Act more workable for construction without destroying the principles of the Act.

Insofar as wage stabilization in the construction industry is concerned, you are all familiar with the fact that the Construction Industry Stabilization Commission was set up as a subsidiary board to the main Wage Stabilization Board. The purpose of the commission was to handle matters pertaining to the construction industry. In that way, members of the commission could apply special construction knowledge to the handling of wage cases peculiar to the construction industry. Last month when the industry members of the Wage Stabilization Board abandoned it as useless because of the President's overriding its stabilization effort, the industry members of the CISC considered what course they should take. The opinion prevailed that with only public members constituting a committee replacing WSB, the situation required administration by construction people somewhere

*Presented before The Pipe Line Contractors Association, Houston, Texas, January 19-21, 1953.

†Executive secretary, The Pipe Line Contractors Association.

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down the line. The industry members of CISC, therefore, decided to remain on the CISC temporarily, since it in no way embarrassed the sound position taken by the industry members of WSB and would give contractor representation in the handling of the remainder of the program rather than abandoning it to the managment of public members alone or possibly the U. S. Department of Labor. There is no conjecture as to whether the new administration will immediately terminate wage stabilization as soon as it takes over or continue wage stabilization until the termination of the Act. Under the Defense Production Act of 1950, which expires April 30, 1953, the President has authority to decontrol or suspend controls entirely if he sees fit. Some informed opinion in Washington now is that Wage Stabilization will be shortly abandoned or so weakened during its last days that no bargaining group should depend on wage controls entirely to keep wage rates and working conditions in line. This must be done in the initial bargaining.

Getting back to the subject of labor-management relations generally, we find that 11 states have enacted state labor relation acts similar to the National Labor Relations Act. These states are Colorado, Connecticut, Kansas, Massachusetts, Michigan, Minnesota, New York, Pennsylvania, Rhode Island, Utah, and Wisconsin. Twenty-six states have enacted legislation placing limitations on the legality of closed shop and union security limitations. No attempt will be made at this time to analyze the various regulations in effect in these 26 states, but you may be interested in a list of the states having such closed shop and union security limitations. They are Arizona, Arkansas, Colorado, Connecticut, Florida, Georgia, Iowa, Kansas, Massachusetts, Michigan, Minnesota, Nebraska, Nevada, New Hampshire, New Mexico, New York, North Carolina, North Dakota, Pennsylvania, Rhode Island, South Dakota, Tennessee, Texas, Utah, Virginia, and Wisconsin.

Texas has, for example, what is known as a right to work law. This law provides in part as follows: "No person shall be denied employment on account of membership or non-membership in a labor union." In view of the provision on the Taft-Hartley Act, which provides that union shop contracts are legal only in those states that do not have state laws prohibiting such contracts, the Texas law becomes of considerable importance.

Before leaving the subject of labor-management relations, brief notice should be given to the existence of the wage and hour law with which most of you are undoubtedly familiar. No one is concerned with the provision setting the minimum wage at 75 cents per hour. The part of the act that has given rise to some investigation and penalty against some contractors is the determination of whether or not some employees are classified as executive or administrative employees and therefore exempt from the requirement that they be paid time and one half the regular rate for any hours worked in excess of 40 hours per week. As a general rule, it might be stated that most employees of a pipe line contractor should be paid on an hourly rate whether the employee be engaged as a timekeeper, a night watchman, or a clerical employee. If you have not already done so, you should take steps to become familiar with these povisions of the Wage and Hour Law.

Contractor's Licenses

These state laws are of considerable importance to every pipe line contractor and the states in which licenses are required should be known by each contractor so that at the time he bids or obtains a job in one of these states, he will be aware of the fact that it will be necessary for him to obtain a license to do business in that state regardless of the form or organization under which he is operating, that is sole proprietorship, partnership, or corporate. There follows a list of the states imposing state contractor's licenses.

In Alabama, Arkansas, South Carolina, Tennessee, and Virginia, there are boards issuing contractor's licenses, which meet at stated times. In Alabama, Arizona, New Mexico, and Virginia, a foreign corporation is required to state it is qualified as such when applying for certain contractor's licenses. In addition in Virginia, an unlicensed foreign cor-

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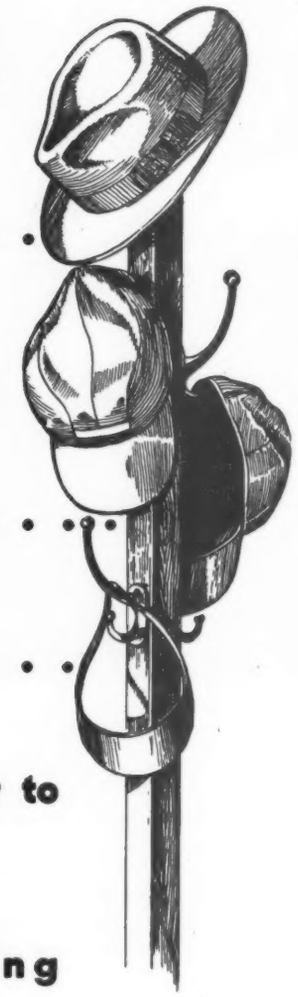

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poration, before bidding on any contract, must, under the State General Contractor's License Requirements, appoint the Secretary of the Commonwealth as its agent for the service of process.

States in which contracting companies are required by statute or ruling to obtain contractor's licenses *before bids may be submitted* are Arizona, Arkansas, Kentucky, Mississippi, Nevada, New Mexico, North Carolina, South Carolina, Tennessee, and Virginia. Again no attempt will be made to outline the requirements for obtaining a license in each of these states, but the existence of a license law presents a strong reason why a corporation considering withdrawal from any of these states should retain its status by continuing qualified and by keeping its contractor's licenses in full force, where there is any possibility of obtaining future business. If this is done, the contractor will then be enabled to bid and proceed to carry out its contracts without delay or embarrassment.

It might also be noted that in general sub-contractors doing work for a prime contractor who holds a general contractor's license. This may vary, however, from state to state and inquiry should be made in the particular state before a decision is definitely made.

One other notation that might be made is the fact that in some states the boards authorized to grant licenses meet only at stated regular intervals and if a contractor should be seeking to obtain a license in order to be qualified to bid on work, for instance in February, he might be confronted with the fact that the next regular meeting of the board is in April and the state law may provide that no licenses may be issued except at regular meetings of the board. Therefore, as much foresight as possible should be given to the obtaining of such licenses.

Income Taxes

No reference is made at this point to the Federal income tax with which all of you are familiar and with which all of you are burdened. This discussion has particular reference to the taxation of net income in the various states. Gross income taxes or gross receipts taxes will be discussed later on. Personal or individual income taxes ordinarily apply to all natural persons as individuals and also in their status as partners, trustees, executors, administrators, and other fiduciaries, and as beneficiaries, devisees, legatees, etc. Partnerships were at one time taxed as entities in several states in the same manner as corporations, but now personal income tax statutes of the various states almost uniformly provide that an individual carrying on business in partnership shall be liable for income tax only in his individual capacity and shall include in his gross income the distributive share of the net income of the partnership received by him during the taxable year. Corporation taxes at the present time are about equally divided between direct income taxes and privilege taxes measured by income. Both types of tax may be provided in the same statute, applicable to different classes of corporations.

Although a few states tax the net income of residents only, the tax is usually imposed on the entire net income of residents, and the net income of nonresidents from property located or business, trade, profession or occupation carried on in the state. The United States Supreme Court has recognized that a state may tax the income of nonresidents earned within the state.

Graduated rates varying from 1 per cent to 15 per cent are generally employed, although a few states impose taxes on individuals at flat rates. A great majority of states impose income taxes upon corporations at flat rates ranging from 2 per cent to 8 per cent. Several states have adopted the graduated basis of rates for corporations as well as for individuals, but with different scales, whereas a few states use the same graduated basis.

Nearly all state statutes follow the Federal law in enumerating income from various sources and concluding with an omnibus clause designed to reach all income from whatever source unless specifically excluded. A few states use net income as reported to the United States, with few adjustments.

Although a state may not impose a privilege tax upon a foreign corporation engaged exclusively in interstate commerce, a portion of the income of non-

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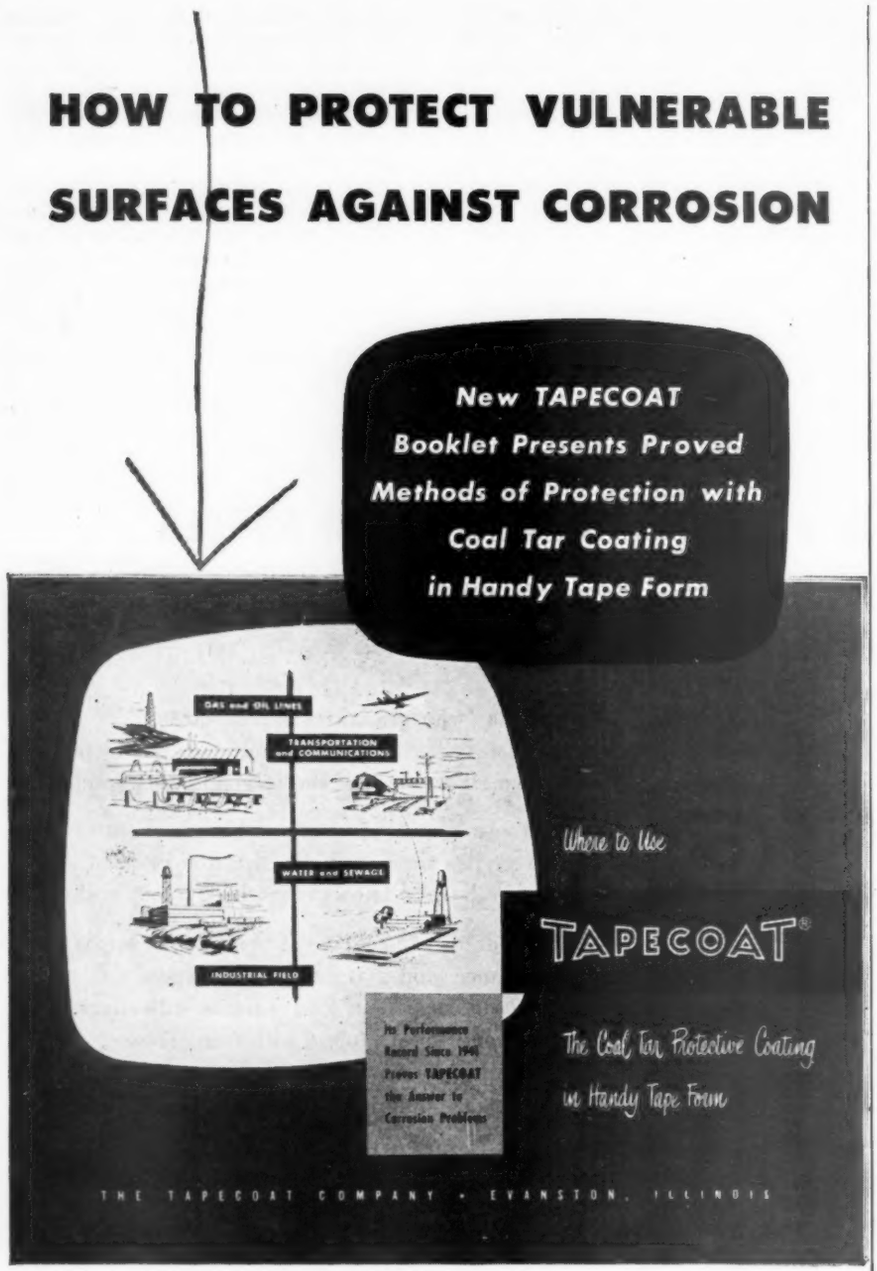

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resident or foreign corporation having some local business or property may be attributed to the state, although derived from interstate operations in part outside the territorial limits of the state. Where all net income is not taxable by the state, there are three general methods of arriving at the proportion properly taxable: (1) Separate accounting; (2) allocation of particular classes of income to the state in which they may be said to have a taxable situs, and (3), apportionment by methematical formula.

Nearly all states having personal income taxes have provisions for information returns. Every person, firm, or corporation within the jurisdiction making payments of interest, rent, salaries, wages, etc., to any taxpayer in a taxable amount is required by statute or by regulations made pursuant to statute to make an annual return of such payments to the taxing officials for information purposes. Some states provide by statute or by regulation pursuant to statute for the withholding of the amount of tax due upon some or all of such payments and for payment of such amount so withheld at the source to the state. Withholding is usually required only as to nonresidents on account of greater difficulty of collecting from the recipients of such cases.

The following states have personal income tax laws; the provisions, of course, vary from state to state and no attempt is here made to set forth such distinctions: Alabama, Arizona, Arkansas, California, Colorado, Connecticut, Delaware, Georgia, Idaho, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Minnesota, Mississippi, Missouri, Montana, New Hampshire, New Mexico, New York, North Carolina, North Dakota, Oklahoma, Oregon, Pennsylvania, Rhode Island, South Carolina, Tennessee, Utah, Vermont, Virginia, and Wisconsin.

Property Taxes

One of the oldest and most firmly established forms of taxation, as well as a principal source of revenue in every state, is that of ad valorem or property taxation, that is, taxation imposed upon the ownership or use of property, or upon the property itself, and measured by the value of the property taxed. Such taxes are found in every state and in one state or another reached nearly every form of property that may be the subject of ownership, whether real, tangible, or intangible. In the furtherance of public policy, nearly every state makes constitutional provision for exemption from taxation of certain classes of property that otherwise would be taxable.

The basic principle of the general property tax is the proposition that property shall be assessed for taxation at its fair cash value, estimated at the price it would bring at a fair voluntary sale. On account of the pressure upon all local assessing officials to keep local valuations low, and thereby reduce the amount of state or county taxes required to be paid by the district, very

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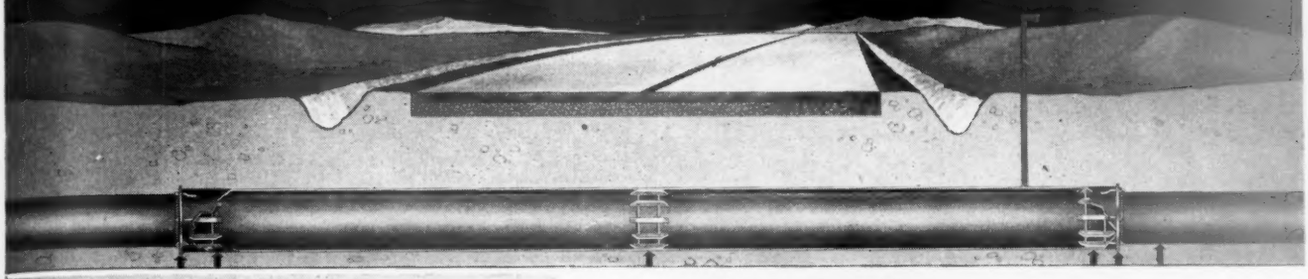

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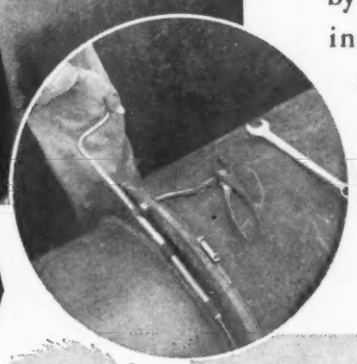

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few states are successful in obtaining an assessment upon the full cash value or similar basis as directed by statute. In states having central agencies for the equalization of assessment, the amount of under assessment may be fairly uniform throughout the state. In other states there may be wide variations. Oftentimes, the practice acquires the force of custom and usage either as to property in general or particular classes thereof and thereby acquires a degree of official sanction. Some states provide by statute that assessment shall be upon the basis of a certain percentage of full value, but whatever the statutory basis, the problem of under assessment is unchanged.

The question of situs of property, that is, the jurisdiciton of the state at common law and under the 14th Amendment to tax property, is of the greatest importance, particularly in the case of personal property. The problem is threefold: (1) Has the state jurisdiction at all; (2) if so has the state made provisions for giving the property a taxable situs within the state, and (3), to what political subdivision of the state has the property been allocated for taxation? It has been definitely settled by the United States Supreme Court that a state may not tax tangible personal property found beyond its borders, although property temporarily outside the state, such as construction equipment, may be taxed at the domicile of the owner.

All sales, use, and gross receipts taxes are based on a gross amount. Deductions for losses or for necessary business expenses allowed under net income taxes, are, with few exceptions, not allowed. A tax upon gross receipts affects each transaction in proportion to its magnitude and irrespective of whether it is profitable or otherwise. A tax upon net profits does not arise at all unless a gain is shown over and above expenses and losses, and the tax cannot be heavy unless the profits are large.

Whether the tax constitutes an undue burden upon interstate commerce is the primary question of concern in determining the validity of a sales, use, or gross receipts tax under the Federal constitution, which delegates to Congress the power, "to regulate commerce with foreign nations, and among the several states." A long line of decisions seems to settle beyond any doubt that a tax cannot be imposed upon or with respect to gross receipts from interstate commerce; but if the tax was an excise conditional upon carrying on a local business and the effect on interstate commerce was remote, the tax is valid.

Taxes measured by sales, that is, on the gross receipts from sales, are known as occupation or license taxes. Taxes based on both sales and services are common to a number of states. It is with respect to this latter type of taxes that pipe line contractors are mostly affected. Some 33 states have a sales or use tax of one form or another. Commerce Clearing House reports the following states have such taxes covering the occupation of contracting. The rate in each state is set opposite the name of the state.

State	*Rate of tax*
Arizona	1 per cent
Louisiana	$30 to $4000
Mississippi	1 per cent
New Mexico	2 per cent
West Virginia	2 per cent

It hardly need be stated that the foregoing discussion has merely hit the highlights of various state laws and regulations that might affect pipe line contractors doing business in those states. The Bureau of Contract Information, Inc., Washington, D. C., is a nonprofit organization serving contractors and awarding officials for the purpose of providing a national clearing house for information relating to the responsibility and contract performance of contractors. Operating income is derived from annual subscriptions of bonding companies. This organization yearly publishes a summary of state regulations and taxes affecting general contractors and you can probably obtain a copy of this booklet from your bonding company.

It may very well be if the need exists that the association should establish a service for the use of its members to provide information concerning various laws and regulations that may be encountered in various parts of the United States. * * *

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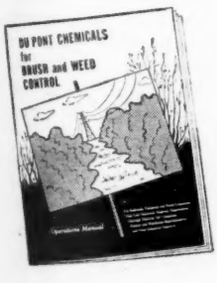
- **Control lasts for years, saves labor of hand cutting or annual spraying.**
- **Reducing to a minimum the hazard of damage by spray drift.**
- **Not hazardous to operators, livestock or wildlife. Nonflammable.**



Free illustrated booklet describes how to control brush in rights of way with Du Pont "Ammate" weed and brush killer. For your copy, write Du Pont, Grasselli Chemicals Dept., Wilmington, Del.

On all chemicals always follow directions for application. Where warning or caution statements on use of the product are given, read them carefully.

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News

First AGA Transmission And Storage Conference

The first American Gas Association Transmission and Storage Conference will be held April 30 and May 1 at the Edgewater Beach Hotel, Chicago. The conference will replace the Natural Gas Spring Meetings, which have been discontinued with adoption of the revisions to the association's constitution and by-laws eliminating separate manufactured and natural gas departments in AGA. While the spring conferences were aimed primarily at top executives, the new conference will be devoted to subjects of interest to operating and technical men engaged in the production, transmission, and storage of natural gas.

A program committee, now engaged in selecting the subjects and the speakers for the two-day conference, hopes to have the advance porgram available for distribution within the next month. The committee comprises: Walter H. Davidson, Transcontinental Gas Pipe Line Corporation, Houston, chairman; Fenton H. Finn, New York State Natural Gas Corporation, Pittsburgh; Julian L. Foster, Lone Star Gas Company, Dallas; F. A. Hough, Southern Counties Gas Company, Los Angeles; Joe T. Innis, Northern Natural Gas Company, Omaha; Frederick J. Pfluke, Rochester Gas and Electric Corporation, Rochester, New York, and Dr. Channing W. Wilson, Consolidated Gas Electric Light and Power Company of Baltimore. J. Stanford Setchell, secretary of the Operating Section of AGA, which is sponsoring the conference, will serve as secretary of the committee.

Present plans call for general sessions on both mornings of the conference, with parallel luncheon sessions, extending into the afternoons, on such subjects as compressor station operations, pipe line construction, maintenance, pipe line cleaning, rights-of-way, legal statutes and lease forms for underground storage, communications systems, and problems of dispatching. The luncheon sessions will be informal, off-the-record discussions designed to provide a free exchange of information between personnel engaged in similar activities. The committee will welcome further topics for consideration. Requests for hotel reservations should be sent direct to the hotel.

Mid-Continent Pipe Line Occupying New Offices

The operating department of Mid-Continent Pipe Line Company is occupying new offices on the first floor of the Mid-Continent Building, in Tulsa, Oklahoma, having moved from an upper floor of the same building the latter part of the year. The new headquarters include the entire floor and provide additional space that was much needed in the company's expanded operations. The offices were redecorated throughout.

Mid-Continent Pipe Line, which operates entirely within the state of Oklahoma, handles more oil direct from lease connections than any other gatherer in the state, more than 70,000 bbl a day.

World's Largest Microwave System. Dr. W. R. G. Baker, General Electric vice president and general manager of its Electronics Division (left), discusses with Claude Williams, president of the Transcontinental Gas Pipe Line Corporation, the microwave radio communication system GE has completed along Transcontinental's 1840-mile pipe line from Texas to New York. It is the world's longest microwave system for private use. Lights on the map indicate the 23 communicating stations in the microwave system. There are 36 other stations serving as automatic repeaters.

Western Pipe Liners Club Holds Winter Session

The Western Pipe Liners Club, 46 strong, held a most enjoyable winter session at the Turf Club in Rivera, California, on the evening of January 15, when the honor guest was recently retired Harry Brown of the Hood Construction Corporation. It was disclosed during the course of the meeting, incidentally, that George Hood, the construction organization founder, and Harry Brown, have acquired a site on the Colorado River, between Parker Dam and Blythe, where they are jointly building a cabin that will be appropriately known as Pipe Liners Retreat.

Jack Pate, the Union Oil Company pipe line superintendent, presided over the gathering in his usual capable manner, and as a sort of after-dinner treat offered an entertaining Alcorn production in color, entitled, "What I Saw in Venezuela." Besides being entertaining, this was a highly educational film, which Tony Alcorn, assistant pipe line manager for Shell Oil Company, photographed during a protracted stay in Venezuela and on sundry trips, including one by air to Maracaibo with Fritz Karge. The picture, exhibited by the producer himself, shows everything from orchids to bullfights, not omitting pipe lines, refineries, the beautiful headquarters of Shell Company at Caracas, how the rich people live, how the poor people live, and all the flora and fauna of this most interesting republic.

Next meeting of the Western Pipe Liners Club, according to Earl Cammack, the perennial secretary, will be held in Santa Maria, sometime during the month of April.

Pipe Line Welding Standards Published

The American Petroleum Institute announces the publication of a "Tentative Standard for Field Welding of Pipe Lines."

The standard was prepared by a formulating committee composed of representatives from the Amercian Gas Association, National Electric Manufacturers Association, Pipe Line Contractors Association, American Petroleum Institute, and other groups. The committee had the cooperation of many engineers interested in design, construction, and operation of oil and gas pipe lines.

The new standard is to apply only to crude petroleum and petroleum products trunk lines and to natural gas transmission lines. It is designed to insure the production of the highest quality welds obtainable on a commercial basis by skilled welders using approved procedures, materials, and equipment.

Appended to this standard is a section on radiographic inspection of pipe line welds. This section represents an effort by the committee to outline a general guide for those who use radiographic methods of inspecting pipe line welds. It has been included for the benefit of those who may wish to use this technique with the hope that their experience and comments may ultimately provide a sound basis for its inclusion in the standard as an established practice.

Copies of the publication "API Std 1104, Tentative Standard for Field Welding of Pipe Lines," may be ordered at 50 cents a copy from J. A. McNally, American Petroleum Institute, 50 West 50th Street, New York, N. Y.

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This is it . . . a screwdriver . . . the only tool needed for quick field replacement of Philco microwave units. Philco microwave is the answer to the need for swift, reliable communications. Philco design emphasizes minimum field maintenance time and cost. All major components are "packaged units", quickly and easily replaced on the site with only a screwdriver, permitting convenient depot checkout, for fullest use of field time.

Using JAN (Joint Army-Navy) specification components wherever applicable, Philco microwave is the only equipment available for commercial use with such high standards of quality. Philco microwave gives propagation and equipment reliability unmatched in the field . . . you should investigate.

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NACE Program Includes Four Pipe Line Sessions

Three discussion sessions and a symposium on cathodic protection have been scheduled to interest the pipe line industry at the March 16-20 Ninth Annual Conference and Exhibition of the National Association of Corrosion Engineers. The technical sessions and exhibition will be held at the Sherman Hotel, Chicago.

Sessions scheduled are a round table discussion of general pipe line problems, of which M. C. Callahan of Gulf Refining Company's Tulsa Pipe Line Division will be chairman; pipe line coatings with E. R. Lopez of The Barrett Division, Allied Chemical and Dye Corporation, New York, as chairman; cathodic protection symposium, with E. P. Doremus, of Cathodic Protection Service, Houston, as chairman, and pipe line group discusisons, to be moderated by A. L. Stegner, Tennessee Gas Transmission Company, Houston.

The session under the leadership of Callahan will be held from 2 to 4:15 p.m. Thursday, March 19, and will consist of an open discussion of pipe line problems. Similar sessions have been the highlights of past conferences.

Lopez has selected ten persons acquainted with various aspects of the pipe line coating industry to participate in the discussion.

The group discussions symposium under the direction of Stegner is scheduled for Wednesday morning, March 18, from 9:00 to 11:30 a.m. These will consist of discussions of pipe line problems. In order to generate more participation, a number of small groups will be formed with discussion leaders for each. An effort will be made to limit the size of each group to about 40 people and provide sufficient groups to accommodate everyone.

Doremus will conduct the cathodic protection symposium at 9:00 to 11:30 a.m. Thursday morning, March 19.

Accelerated Amortization Subject of FPC Meeting

The Federal Power Commission announces that it will hold an oral argument March 11 in Washington, D. C., on the issue of what rules, if any, it should adopt relating to the treatment for accounting and rate-making purposes under the Federal Power and Natural Gas Acts of tax savings resulting from the allowance of accelerated amortization in income tax computation.

The FPC pointed out that the Defense Production Administrator, as certifying authority, had as of last October 22 issued certificates to persons subject to the Federal Power Act relating to a gross investment of $2,495,212,000, of which $1,176,439,000 was certified for rapid amortization. As of that same date, persons subject to the Natural Gas Act had received certificates covering a gross investment of $386,297,000, of which $97,289,000 was subject to accelerated amortization.

Rate Increase Applications Establish Record in 1952

The Federal Power Commission acted upon a total of $148,953,00 annually in wholesale natural gas rate increase applications filed by 30 companies during 1952, Chairman Thomas C. Buchanan announces. This total represents a 65 per cent increase over the $97,966,000 filed in 1951.

Out of the total acted upon in 1952, the FPC suspended $148,101,000 and accepted the remaining $852,000. Of the filings suspended during 1952, increases totaling $26,463,000 were allowed to become effective, $7,750,000 were disallowed, and the companies were permitted to withdraw $4,700,000. Out of the remaining $109,188,000, a total of $8,586,000 became effective under bond during the year pending final disposition by the commission, and $100,602,000 were still under suspension.

The commission during the 12-month period completed proceedings, which were pending at the close of 1951 and carried into 1952, amounting to $56,355,000. This total includes $20,395,000 allowed to become effective, $29,514,000 disallowed, $6,446,000 withdrawn.

Thus, considering rate increases filed during the calendar year and carryovers from previous years, proceedings involving $95,268,000 were concluded. Of the entire amount, a total of $46,858,000 was allowed to become effective, $37,264,000 was disallowed, and $11,146,000 was withdrawn.

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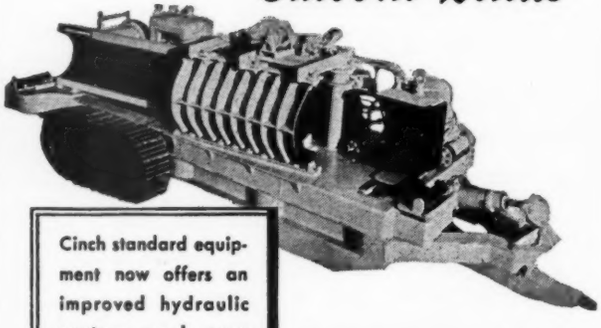

Cinch standard equipment now offers an improved hydraulic system and new wedge-type pin-up slide for greater durability and speed. If desired, even faster, easier maneuvering can be obtained with Athey tracks and hydraulic lift tongue.

Contractors swear by Cinch "Smooth Bend" Pipe Benders for dependability and uninterrupted service. Cinch Pipeline Equipment provides the most up-to-date equipment and expert maintenance.

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SOIL RESISTIVITY TESTING

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- TOUGH . . . steel case . . . shatterproof glass . . . baked enamel scale
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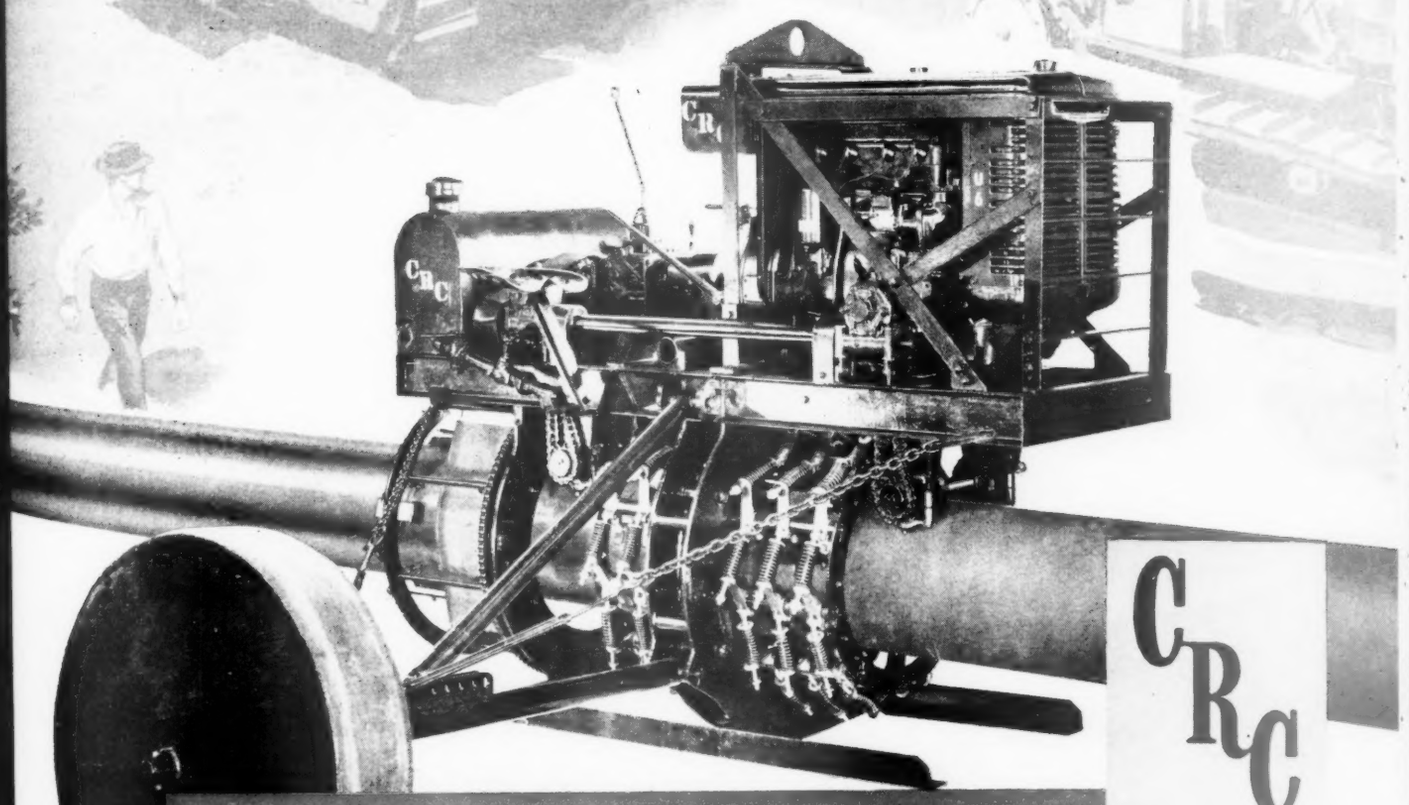
FAST, FLEXIBLE CLEANING AND PRIMING MACHINES

You can tell immediately that the C-R-C Model "C" and "CR" Cleaning and Priming Machines are built by men who *know* pipelining. Simplicity and safety are stressed in the design. The low center of gravity gives perfect balance for easy handling. C-R-C machines clean over sags, sidebends, and overbends. The Model "CR" Cleaning Machine with the counter-rotating heads, is especially adaptable for reconditioned pipe, and insures proper cleaning of both sides of the seam weld. All head parts ride over welds and wrinkles without binding. Machines are available for all pipe sizes from the smallest to the largest. Write now for the C-R-C Catalog for details on the features and economies of the C-R-C Model "C" and "CR" Cleaning and Priming Machine.



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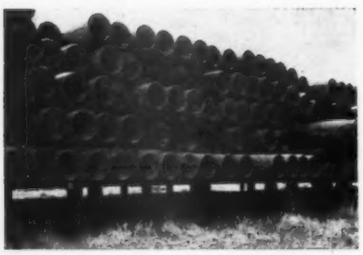
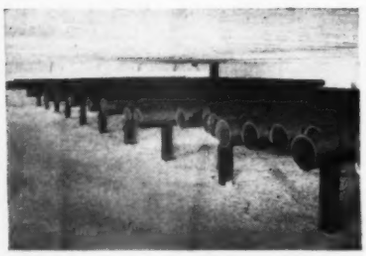
FIRST plant to establish electrical holiday detection for the entire surface of every length of your coated and wrapped pipe. This holiday detection permits the repair of all holidays, before your pipe passes final inspection.



FIRST plant to build storage skidways far enough above ground so that spattering of rain, snow, and mud does not cause ground corrosion on the underside of your pipe. This means better pipe protection of your pipe while in storage.



FIRST plant to build several primer drying areas, each over 100 feet in length, to properly age the primer before the hot enamel coating is applied. High velocity warm air is circulated to control primer drying time which assures maximum bond of the coating and wrapping to the pipe.

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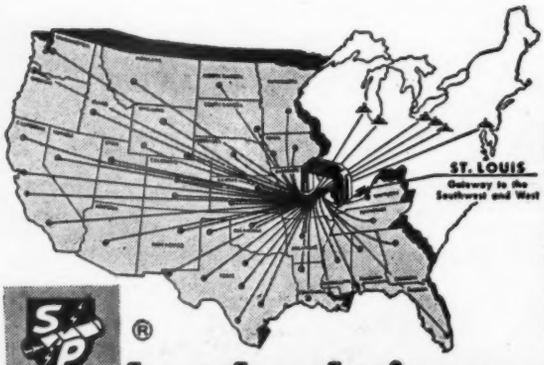

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News

John Truman, Pioneer Pipe Line Contractor, Dies

John C. Truman, of El Dorado, Kansas, one of the pioneers in the pipe line construction industry, passed away in February. He was 69 years of age and had been ill 14 months.

Truman first became connected with the oil industry in 1906 when he resigned his job as a train dispatcher with the New York Central Railroad to accept a position in Indianapolis with the Ohio Oil Company as clerk and operator.

He moved to El Dorado in 1917 as Kansas superintendent for the Sinclair Pipe Line Company, which position he held until his resignation in 1919 to organize the Truman-Rayl Construction Company, to do pipe line contracting work. He purchased the interest of his associates in March, 1926, and immediately sold a half interest to Ray L. Smith to form the Truman-Smith Construction Company. After the dissolvement of that partnership years later, Truman continued in pipe line construction with his own firm until his retirement a number of years ago. He maintained his contact with the industry, however, through his honorary membership in the Pipe Line Contractors Association.

In addition to his business activities, Truman took an active part in affairs of his community. He was a member of the city commission of El Dorado for four years, served as mayor for two years, was a member of the county commissioners for four years, and served as chairman of the board for two years. He was a member of the First Methodist Church, Rotary Club, a director of the El Dorado National Bank, a member of the Chamber of Commerce, and the El Dorado Country Club.

Platte Pipe Line Enters Wind River Basin Area

Platte Pipe Line Company's entry into the Wind River Basin area of Wyoming has been announced by Millard K. Neptune, president, after the company purchased pipe line.

Extension of Platte Pipe Line's facilities to that important oil producing region was made possible by the purchase by Platte from Service Pipe Line Company of one of two 8-in. lines owned by the latter company. The 91 miles of line purchased will receive oil at Maverick Springs, Pilot Butte, and Steamboat Butte, and deliver it to Platte Pipe Line Company's present station at Lost Cabin, Wyoming.

Tariffs under which the oil will move from the Wind River Basin area over the Platte Pipe Line have been published and are effective as of February 3. The Interstate Commerce Commission has issued a special order permitting the issuance one day's notice rather than the normal thirty-day notice. The Wyoming Public Service Commission also approved the transfer of the facilities to Platte.

Platte Pipe Line Company is owned by the British-American, Continental, Ohio, Pure, and Sinclair oil companies.

On varied field applications like these . . .

Johns-Manville TRANTEX *polyvinyl* TAPE

gives lasting protection against pipeline corrosion!

ON JOB AFTER JOB, Johns-Manville Trantex Tape is controlling corrosion and extending the service life of underground gas and oil pipelines.

Trantex is a durable plastic tape that sticks on contact—bonds tightly to the pipeline. No heat or heavy duty equipment is needed in its application. It is easily applied by hand or by specially developed hand-operated machines. Many users have found that field-applied Trantex Tape speeds coating applications . . . lowers construction costs on both large diameter transmission lines and gas distribution systems.

Trantex Tape is a development of Johns-Manville—a pioneer in the manufacture of Asbestos Pipeline Felts. For further information about Trantex Tape, write for copy of PP-26A, Johns-Manville, Box 60, New York 16, N. Y.

	*V-10	**V-20
Dielectric Strength per mil thickness, Approx.	1,000 V	1,000 V
Insulation Resistance, greater than (ASTM-D-257-49)	100,000 megohms	100,000 megohms
Temperature Limit	200 F	200 F
Adhesion oz. per inch width	30	20
Tensile Strength lbs. per inch	30	56
Elongation at Break	250%	300%

"Trantex" is a black polyvinyl tape. It is available in two thicknesses—

*V-10 is a 10 mil tape for average conditions, and

**V-20 is a 20 mil thickness for use where a more rugged coating is specified, such as to repair enamel coatings.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville TRANTEX *polyvinyl* TAPE

PROTECTS PIPELINES AGAINST CORROSION

Gas Use Doubled Every Ten Years Since World War I

James H. Orr, senior partner of Colonial Management Associates and a director of several leading corporations, said recently that "since World War I, not World War II, the use of gas has about doubled every ten years."

Speaking on the Kidder, Peabody, investment firm, radio program ("Your Money at Work"-WOR), Orr told Milton Fox-Martin, Kidder, Peabody's central mutual fund department manager, that "under present price relationships a market exists for all the natural gas that can be produced, distributed and transported," which, he added, "involves a job for the long distance gas pipe lines, already doing a spectacular job increasing service."

The Colonial representative explained that this continuing demand will necessitate new gas field discoveries "which will be found in all of the great sedimentary of the continent, particularly the Tidelands off the Gulf Coast which are most likely to yield gas rather than only oil."

"About one-half the size of Texas," Orr continued, "the Tidelands runs to the shore to a depth of 600 feet." He defined the 60-ft level as the most economical in which to drill, stating that this horizon constitutes an area of 16,000 square miles. "According to geologist Ralph E. Davis," Orr pointed out, "ten thousand of Pure Oil's 25,000 Tidelands lease acres in Louisiana would indicate a natural gas reserve more than 3 trillion cubic feet — enough to serve a city the size of Chicago for 27 years and still allow room for expansion."

Pipe line exhibits being selected for International Petroleum Exposition May 14-23, in Tulsa, Oklahoma. J. R. Polston, seated, chairman of the transportation sub-committee for the museum at the oil show, vice president of Service Pipe Line Company, Tulsa, recently met with his group to determine qualifications for exhibits. A prospective exhibit was presented by Charles Keane, chief engineer, Great Lakes Pipe Line Company, Kansas City. Other representatives of the group, focusing attention on the model, are, left, Bob Randolph, district sales manager, General American Transportation Company, Tulsa; and, right, G. L. Brennan, manager of LPG division, Warren Petroleum Company, Tulsa.

First Oil Through West Texas Gulf Line

First oil for the new West Texas Gulf Pipe Line has been received at the Colorado City, Texas, pumping station from Permian Basin gathering lines and started on its way to the Gulf Coast and the Mid-Valley area, J. H. Russell, president of West Texas Gulf has announced from Houston on February 10.

Construction of West Texas Gulf, largest diameter crude oil pipe line in the Western Hemisphere (26 in.) is not yet complete in all details, Russell said; however, it is in actual operation. Formal dedication ceremonies are now planned for late April or early May.

FPC Requires More Data From Companies

The Federal Power Commission has issued an order amending its rules by revising Form No. 11, Monthly Statement of Operating Revenue and Income covering Natural Gas Companies, to call for additional information from the reporting companies.

The revised form, which is now effective, is to be used for monthly statements beginning with January, 1953.

Form No. 11, as revised, is designed to obtain monthly information concerning gas operating revenues, revenue deductions, and income. The information includes (1) detail of operating expenses by functional account groups, including a statement of the cost of purchased gas and the volume purchased; (2) interest charged to construction; (3) gas construction work in progress; (4) gas materials and supplies; (5) volume and value of gas stored underground, and (6) dividend appropriations.

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MIXER

The SHORTSTIR Mixer, installed in crude oil pipe line storage tanks, pays for itself by preventing sediment accumulation. It eliminates costly tank clean-out . . . down time for clean-outs . . . loss of marketable oil . . . makes chemical treating unnecessary in most cases or improves efficiency of treatment where required . . . and maintains maximum storage capacity. Installation usually costs less than one clean-out and yields appreciable future savings.

For a rugged, dependable, trouble-free mixer — specify SHORTSTIR.

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Platte Awards Contract For $3,000,000 Extension

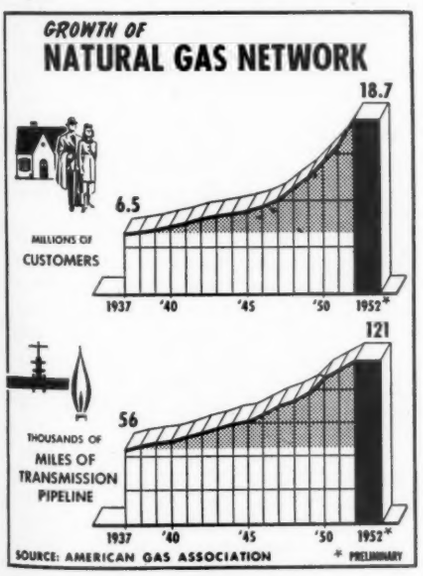
Platte Pipe Line Company, of Kansas City, Missouri, has awarded a contract to R. H. Fulton and Company, Lubbock, Texas, for the laying of 91 miles of 12-in. and 14-in. pipe line in Wyoming. This $3,000,000 extension will permit Platte to serve directly the Byron and Oregon areas of Wyoming's Big Horn Basin. At present, the Platte line extends westward only as far as its Chatham station, which is approximately 17 miles southwest of Worland, Wyoming.

Platte Pipe Line Company, which is owned by the British-American, Continental, Ohio, Pure, and Sinclair oil companies, just recently put in operation its new $60,000,000, 20-in. diam crude oil pipe line, which is capable of transporting over 100,000 bbl of oil a day from the Rocky Mountains to its terminus at Wood River, Illinois. At Wood River, deliveries are made to refineries in the St. Louis area and to other pipe lines for transportation to points further East.

Canadian Line in Operation

Canadian Gulf Pipe Line Company placed in operation its 115-mile crude oil line during February. The line extends from the Fenn-Big Valley-Stettler area to the Interprovincial Pipe Line Company terminal at Edmonton.

The section from New Norway north to Edmonton went into operation first. Operation south of New Norway was delayed a few days pending completion of certain Interprovincial tankage needed for handling Stettler type crudes. Work started last summer.



Expansion of natural gas service to large new populated areas in recent years has made this industry one of the fastest growing in the United States. The national pipe line network more than doubled in the past 15 years and the number of states using natural gas rose from 34 to 42. In the past five years more new natural gas customers were added to utility gas lines than in the previous decade. Gas reserves during this period increased steadily as new discoveries consistently exceeded production.

Pair of Pipe Line Profitmakers!

Here are two UNIT TRENCHOES speeding up the ditching operation on a cross country pipe line project. This type of operation is familiar to pipeline contractors because they know, when the going gets tough, it takes a rugged machine to do the job efficiently. UNIT TRENCHOE is this type of machine. Its fast operating speed is a real time and money saver on pipe line work. UNIT'S exclusive mechanical features, together with the streamlined FULL VISION CAB, make UNIT a front line machine in the pipe line construction field.

Then there are Mobile UNITS for jobs along the right-of-way. Mobile equipment offers road travel speed, plus sufficient traction to operate in rugged pipe line terrain.

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½ or ¾ YARD EXCAVATORS...CRANES UP TO 20 TONS CAPACITY
CRAWLER OR MOBILE MODELS . . . GASOLINE OR DIESEL

All Models Convertible to ALL Attachments!

Pipe Line Personals

E. A. Koenig has been appointed vice president in charge of operations for Wilcox Trend Gathering System, Inc., of Dallas, according to an announcement by **Harry W. Bass,** president of the corporation. Koenig was formerly general superintendent of Texas Eastern Transmission Corporation. **J. C. Riddle,** former division chief dispatcher for Texas Eastern's division four, and **S. L. Windham,** former measurement engineer in that division, have also accepted positions of increased responsibility with Wilcox.

Koenig, who joined Texas Eastern in 1947 as superintendent of compressor stations and served as general superintendent of the company from August, 1947, to the time of his resignation, has had a long productive career in the oil and gas industry. He has been on leave of absence from Texas Eastern since April 9, 1952, when he was called to Washington, D. C., to serve as chief of the Gas Transmission Branch, Gas Operations Division, Petroleum Administration for Defense, U. S. Department of the Interior. He has been released from his government appointment to accept his new duties.

Wilcox has been authorized to construct approximately 150 miles of pipe line extending from a point in the Hagist Ranch field in McMullen County, Texas, to a point of connection with Texas Eastern's system near Provident City, Texas. The project will include approximately 85 miles of lateral and gathering lines and a 220-hp compressor station.

Allen R. Heidebrecht

Allen R. Heidebrecht, senior electrical engineer for Platte Pipe Line Company, has been promoted to chief engineer with headquarters in Kansas City, Missouri. A Kansan by birth, he received his education in Kansas schools graduating from Kansas State College in 1934 with a degree in electrical engineering. He joined Platte in 1950 after being associated with Kansas Gas and Electric Company for 16 years.

Platte Pipe Line Company, which recently completed a 100,000-bbl per-day crude oil pipe line from the Rocky Mountains to Wood River, Illinois, is owned by the British-American, Pure, Continental, Ohio, and Sinclair.

Ronald D. Gibbs, vice president in charge of transportation and distribution for Union Oil Company of California, has retired, and **E. L. Hiatt** named to succeed him. Hiatt has been assistant to Gibbs since November, 1950.

Gibbs was graduated from Pasadena high school and the University of California. He joined Union Oil in 1918 as a laborer at the Los Angeles refinery where he served as a pipefitter and machinist helper, and in 1923 was assigned as a junior engineer in research and development. Later he was made foreman of the company's gas plant at Rosecrans. He was appointed assistant manager of operations in 1931 and three years later promoted to manager. After serving as manager of field operations from 1941 to 1944 he was made assistant to the executive vice president and a year later was elected to the vice presidency.

Hiatt was educated at Eastern Oregon College of Education and Golden Gate College, San Francisco. He joined Union Oil in 1933 as a tank salesman. After steadily advancing through various marketing and distribution posts he was made traffic manager at Seattle in 1943 and a year later advanced to distribution manager at San Francisco. He was appointed assistant to the vice president in 1950.

Reese H. Taylor, president of Union Oil, announced the changes.

Earle A. Clark, director of public relations, Northern Natural Gas Company, Omaha, Nebraska, and **Schuyler F. Baldwin,** director of public relations, Rochester Gas and Electric Corporation, Rochester, New York, have been appointed members of the Public Information Committee of the American Gas Association. **Howard A. Praeger,** manager of publicity and advertising department, The Brooklyn Union Gas Company, has rejoined the AGA committee after serving a tour of duty in the U. S. Army as a major of psychological warfare.

AGA's Public Information Committee, headed by **Willis M. Kimball,** director of information, The Columbia Gas System, Inc., New York, directs the execution of a national gas industry information program.

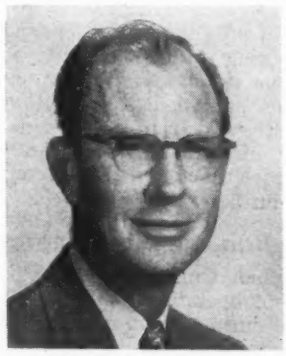
James T. Van Rensselaer, manager news and publications, Southern California Gas Company, Los Angeles, has been appointed a member of the Public Information Committee of the American Gas Association.

He was educated at University of California at Berkeley and worked on newspapers in San Francisco. He joined the publicity department of Southern California Gas Company in 1937 and has been editor of publications since 1942. He is a past president, Southern California Industrial Editors Association and past vice president, International Council of Industrial Editors.

Troy A. Shedd has been promoted to district superintendent in Standard Oil Company's products pipeline department, with headquarters at Chillicothe, Missouri.

Shedd joined Standard as a relief truck driver in 1933, became an assistant maintenance foreman at Maryville, Missouri, in 1942, and maintenance foreman in 1947. During construction of the products pipe line from the company's Sugar Creek, Missouri, refinery to Dubuque, Iowa, he served as chief inspector of a section of the line.

As district superintendent he will be in charge of Standard's present pipe line facilities from its Neodesha, Kansas, refinery to Sugar Creek, as well as the new pipe line from Sugar Creek to Dubuque.



Robert L. Bullock

Robert L. Bullock, head of the corrosion unit of the engineering department, Interstate Oil Pipe Line Company, Shreveport, Louisiana, was recently elected a member of the board of directors of the National Association of Corrosion Engineers. Bullock was elected to serve a three-year term representing active members of the NACE in the Ark-La-Tex area. This term of office begins in March, 1953, when all new officers and directors of the association will be installed.

The National Association of Corrosion Engineers is an association of individuals and organizations concerned with control of all types of corrosion.

Bullock has been active in the NACE and corrosion control for a number of years. He has served on numerous speaker panels, and as chairman of the "First Practical School on Corrosion Control Methods." He served as chairman of technical program for the 1952 annual Conference of NACE held in Galveston, Texas.

At the present time, Bullock is serving on a number of committees of the association and is chairman of the Technical Practices Committee on Internal Corrosion of Pipe Lines and Tanks in Sour Crude Service.

John D. Bowers, former district superintendent at St. Elmo, Illinois, for Interstate Oil Pipe Line Company, now occupies a similar position at Wewoka, Oklahoma. **G. S. Bancroft,** Wewoka district superintendent, has been transferred to the Wilson, Oklahoma, district in the same position. **Dallas T. Luttes,** former Wilson district superintendent, is now at St. Elmo.

▸ **E. C. Michels,** Ponca City, Oklahoma, pipe line engineer for Continental Pipe Line Company, has been promoted to superintendent of Pioneer Pipe Line Company, with headquarters in Salt Lake City, Utah. it was announced in Denver by **J. W. Liddell,** president of Pioneer Pipe Line Company and vice president and Rocky Mountain region general manager for Continental Oil Company.

Pioneer Pipe Line Company is owned 65 per cent by Continental Oil Company and 35 per cent by Sinclair Pipe Line Company. Continental Pipe Line Company is a subsidiary of Continental Oil Company.

Michels will supervise operation of Pioneer Pipe Line Company's new 8-in. products pipe line, which extends 291 miles from Sinclair, Wyoming, to Salt Lake City. The Pioneer system, including a petroleum products terminal at Salt Lake City and a pump station at Sinclair, was completed early in January at a cost of about $8,000,000 and is now in operation.

Michels, who was on a two-month construction assignment with Pioneer during the recent building of the 291-mile pipe line, joined Continental Pipe Line Company in Ponca City in 1950. He has served as a Conoco pipe line engineer at McAllen, Texas; Lance Creek, Wyoming, and Ponca City. He is a native of Salina, Kansas, and a graduate of Texas A. & M. College, College Station, Texas.

Liddell also announced the appointments of **Harry Nester,** Ponca City, as chief clerk for Pioneer Pipe Line Company, with headquarters in Salt Lake City, and **Lester Waddell,** also of Ponca City, as superintendent of the pump station at Sinclair. Both men are members of Continental Pipe Line Company's headquarters office staff in Ponca City.

▸ **Norman F. Tietze** has been promoted to division engineer in Standard Oil Company's products pipe line department, with headquarters at Des Moines, Iowa.

Tietze joined Standard in 1948 as an engineer, and later served as a district engineer. In 1952, during construction of the products pipe line from the company's Sugar Creek, Missouri, refinery to Dubuque, Iowa, he was advanced to chief inspector of a section of the line.

As division engineer he will deal with engineering problems of the department's Des Moines, Iowa, division, which includes products pipe lines from Neodesha, Kansas, to Sugar Creek; Sugar Creek to Dubuque; Sugar Creek to Des Moines, and Sugar Creek to Sioux Falls, South Dakota.

▸ **W. E. Golderman,** Toronto Pipe Line Company, Tulsa, Oklahoma, was recently elected to membership in The Pipe Liners Club of Tulsa. Other new members are: **R. P. Hopson,** The Texas-Empire Pipe Line Company, Tulsa; **J. N. Hunter, Jr.,** Service Pipe Line Company, Tulsa; **Eugene F. Hunt,** Service Pipe Line Company, Tulsa, and **Gleason Romans,** Airplane Pipe Line Patrol Company, Tulsa.

Ewing and Burns to Receive NACE Awards

The 1953 Speller and Whitney Awards will be made at Chicago to Scott P. Ewing and Robert M. Burns, respectively. Ewing, corrosion engineer with the Carter Oil Company, Tulsa, Oklahoma and Burns, chemical coordinator and director of chemical and metallurgical research for Bell Telephone Laboratories, Murray Hill, New Jersey, will be the seventh to receive this recognition for outstanding contributions to the development of corrosion technology. The Speller Award, named after F. N. Speller, is in recognition for achievement in the field of corrosion engineering. The Whitney Award named after Willis Rodney Whitney is in recognition for achievement in the field of corrosion science.

The designees will receive the certificates of award at the annual banquet of the National Association of Corrosion Engineers to be held at Hotel Sherman, Chicago, on the night of March 19. The banquet is a feature of the Ninth Annual Conference opening March 16.

N. E. Berry, immediate past president of the association was chairman of the awards committee. Members were Paul W. Bachman, R. H. Brown, D. B. Good, V. N. Jenkins, J. Flynn Johnston, James T. MacKenzie, M. A. Scheil, L. R. Sheppard, R. S. Treseder, S. E. Trouard, H. H. Uhlig, E. W. Vereeke, F. L. Whitney.

▸ **Leslie H. Taylor** has been appointed superintendent of the seven compressor stations in the Lone Star Gas Company's Ranger district it has been announced by **T. J. Skrabanek** of Dallas, superintendent of the compressor department. Formerly assistant district superintendent since November, 1943, Taylor succeeds **Sam M. Gamble** who has been retired under Lone Star's insurance-pension program.

With headquarters in Ranger, Taylor will be in charge of compressor stations at Abilene, Benjamin, Breckenridge, Ballinger, Caddo, Ranger, and the x-ray station near Gordon. He has been with Lone Star since 1922 when he was employed at Gas City in Okla.

▸ **A. R. Hassler** has been made Tulsa wire chief by Shell Pipe Line Corporation, succeeding **G. F. Wallace,** retired. Hassler, who formerly was assistant wire chief, joined the Shell organization in 1923 as a telegrapher at Tonkawa, Oklahoma. He became assistant wire chief in 1934.

▸ **H. M. McDonald** has been appointed general superintendent for Texas Eastern Transmission Corporation and **Paul L. Hughen** has been promoted to pipe line superintendent, according to an announcement by **E. R. Cunningham,** vice president in charge of operations. Others promoted were **Carl R. Sisson,** who replaces Hughen as manager of the corporation's division three in West Chester, Pennsylvania, and **Murrell Carlisle,** who replaces Sisson as assistant manager of that division.

McDonald was employed by Texas Eastern in 1947 and was elevated to pipe line superintendent in May, 1948. He has served as acting general superintendent since April 1952.

Hughen joined Texas Eastern in 1947 and has served as assistant manager of the corporation's division one, and manager of divisions four and three, having been in charge of division three since June, 1951.

Sisson has been employed by Texas Eastern since 1947. He was promoted to assistant manager of the corporation's division two in 1951, and in April, 1952, division three.

Carlisle joined Texas Eastern in 1948 and held positions of engineering inspector and pipe line foreman before being promoted to assistant manager of division three.

▸ **W. R. Yates** has been transferred by Shell Pipe Line to Pasadena, Texas, where he becomes district foreman for Rancho Pipe Line Company. **C. W. Jackson** has been transferred to Livingston, Texas, as district chief gager for Rancho. Both men have been stationed in Shell's Gohlke district.

▸ **W. P. Langley** has been made West Texas area right-of-way and claims representative for Shell Pipe Line Corporation. He succeeds **F. B. Estes,** retired.

To obtain more information on products advertised see page E-43

XUM

PIPE LINE PROJECTS

El Paso Natural Proposes 1778-Mile Line

El Paso Natural Gas Company, of El Paso, Texas, has applied to the Federal Power Commission for authority to construct new pipe line facilities that would carry an additional 400,000,000 cu ft of natural gas a day from points in West Texas, southeast New Mexico, and the San Juan Basin area of northwest New Mexico for delivery to customers in New Mexico, Texas, Arizona, and California. Project, estimated to cost $175,250,000, will include a total of 1778 miles of pipe line and 161,860 compressor horsepower capacity. The proposed new facilities would permit the delivery of an additional 300,000,000 cu ft of gas a day from the Permian Basin in southeast New Mexico and West Texas, and an additional 100,000,000 cu ft daily from the San Juan Basin in northwest New Mexico and southwest Colorado.

Out of the 300,000,000 cu ft from the Permian Basin, 100,000,000 cu ft would be for use jointly by Southern California Gas Company and Southern Counties Gas Company of California, both of Los Angeles; 100,000,000 cu ft for Pacific Gas and Electric Company, of San Francisco; and the remaining 100,000,000 cu ft for El Paso's customers in West Texas, New Mexico, and Arizona. The additional 100,000,000 cu ft from the San Juan Basin would be divided, with 50,000,000 cu ft for use by Southern California and Southern Counties, and 50,000,000 cu ft for Pacific Gas and Electric. All deliveries would be made at the Arizona-California border.

Ohio Fuel to Convert Five Pools to Storage

The Federal Power Commission has authorized the Ohio Fuel Gas Company of Columbus, Ohio, to convert five natural gas pools in Ohio to storage service and to construct about 35 miles of pipe line to permit delivery of approximately 50,000,000 cu ft of natural gas a day into one of the new storage areas.

The FPC action authorizes Ohio Fuel to convert one pool in Ashland and Richland counties to storage use as part of the company's Weaver Storage Area, and to convert 4 pools in Holmes, Wayne and Ashland counties to form a new storage area to be known as the Holmes Storage Area.

The commission, however, denied the company's proposal to convert one pool in Coshocton and Guernsey counties into a new area to be called the Guernsey Storage Area. The FPC said that activation and operation of this storage area is dependent upon the receipt of natural gas from Tennessee Gas Transmission Company, and that a connection would be necessary in order for Ohio Fuel to receive gas from Tennessee. The commission pointed out that Tennessee Gas Transmission has not made application for authorization to establish such a connection.

The commission also dismissed a portion of Ohio Fuel's application involving the proposed abandonment and removal of about 75 miles of well and gathering lines, after finding that the abandonment of these facilities is not subject to requirements of the Natural Gas Act.

In connection with the storage program, Ohio Fuel was authorized to build a 6000-hp compressor station in the Holmes area and approximately 97 miles of pipe line to connect the storage areas with existing transmission facilities.

The 35 miles of new pipe line, also authorized by the FPC, will parallel sections of existing lines in Fairfield, Franklin, Delaware, and Licking counties, Ohio, and will permit delivery of 50,000,000 cu ft of gas a day into the Holmes storage area. These facilities were the subject of a separate application by Ohio Fuel.

Total estimated cost of the facilities, including those denied by the FPC, is $6,555,000; however, credits to fixed capital arising from the retirement of the existing lines that are to be abandoned result in a net increase in investment in facilities of approximately $4,585,690.

California Companies Would Add to Systems

Applications have been filed by Pacific Gas and Electric Company, of San Francisco, California, and jointly by Southern Gas Company and Southern Counties Gas Company of California, both of Los Angeles, California, requesting Federal Power Commission authorization for the construction of natural gas transmission facilities to enable them to transport additional gas proposed to be received from El Paso Natural Gas Company of El Paso, Texas.

Pacific Gas and Electric plans to build about 170 miles of 34-in. main line loops and 15,000 hp in compressor capacity to increase by 151,730,000 cu ft a day the capacity of its 34-in. line extending from a connection with El Paso's system at the Arizona-California boundary, near Topock, Arizona, to a point near Milpitas, California. The company also proposes to connect service to Boron, California, and to supplement service to the Bakersfield, California, area; and to increase the capacity of its line from Milpitas to its East Bay distribution system by construcing 8 miles of line between Milpitas and Irvington, California. Estimated cost is $26,981,851.

Southern California and Southern Counties propose to build approximately 73 miles of 30-in. main line loops and 5280 hp in additional compressor capacity to increase by 151,700,000 cu ft a day the capacity of their existing line extending from a connection with the El Paso system near Blythe, California, to a point near Santa Fe Springs in Southern California. The proposed new facilties will cost about $7,482,194.

El Paso recently filed an application with the FPC requesting authority to construct facilities to supply additional gas to these three California companies, among others.

Hearing on 860-Mile Gas Line Begins March 2

A Federal Power Commission hearing will begin March 2 in Washington, D. C., on an application by Gulf Interstate Gas Company, of Houston, Texas, proposing construction of an 860-mile natural gas pipe line extending from southern Louisiana to a point in northeastern Kentucky.

Proposed project, estimated to cost about $127,887,000, would be used to transport 375,000,000 cu ft of gas a day for the account of United Fuel Gas Company, of Charleston, West Virginia. The gas would be delivered to United Fuel in Boyd County, Kentucky, and to Central Kentucky Natural Gas Company, also of Charleston and an affiliate of United Fuel's, at a point in Montgomery County, Kentucky.

FPC Examiner Favors Kansas-Nebraska Request

A decision has been filed by a Federal Power Commission presiding examiner authorizing Kansas-Nebraska Natural Gas Company, Inc., of Phillipsburg, Kansas, to construct new pipe line and related facilities on its natural gas transmission system in Kansas and Nebraska to increase the total daily capacity by nearly 10,000,000 cu ft, from the presently authorized 182,600,000 cu ft per day to 192,590,000 cu ft.

The project, estimated to cost $2,576,686, includes the construction of about 196 miles of pipe line, the rearrangement of certain compressors, and town border and metering stations to serve four small towns and 16 new industrial customers. Part of the new pipe line will replace sections of existing lines.

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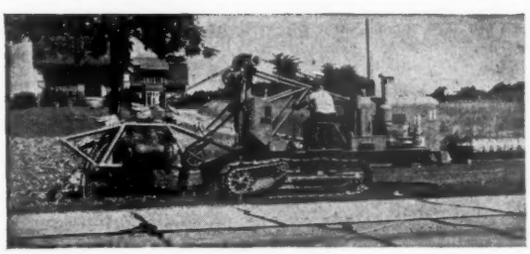

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FPC Authorized Gas Lines Costing $409,476,207 in 1952

Construction of natural gas transmission facilities designed to add more than 1¼ billion cubic feet of daily delivery capacity to the nation's individual pipe line systems was authorized by the Federal Power Commission during the last six months of 1952, Chairman Thomas C. Buchanan announces.

Chairman Buchanan reported that the new facilities authorized during the last half of 1952 involve 2232 miles of natural gas pipe line and have a total estimated construction cost of $174,055,234.

Approximately $164,293,258 of the total construction cost was for major projects—those estimated to cost $700,000 or more. These major projects are expected to benefit 78 cities of 50,000 population or over in 17 states, as well as numerous smaller communities.

These larger projects will increase the daily delivery capacity of the individual transmission systems involved by more than 1,217,000,000 cu ft of natural gas per day, and involve construction of approximately 2078 miles of new pipe line and installation of compressor facilities aggregating 117,360 hp.

The largest single authorization during the six-month period was for Texas Gas Transmission Corporation, of Owensboro, Kentucky, to construct and operate 408 miles of 26-in. loop line in segments on its main line system between Louisiana and Kentucky and 26,860 hp in new and existing main line compressor stations in Louisiana, Tennessee, Indiana, and Kentucky. This project is estimated to cost $33,752,705 and is designed to increase Texas Gas' delivery capacity by 295,000,000 cu ft a day.

The commission during the calendar year 1952 authorized construction of a total of 4147 miles of pipe line and installation of compressor units aggregating 588,095 hp at a total estimated cost of $409,476,207. Major projects costing $700,000 or more authorized during this 12-month period had a total estimated construction cost of $344,023,193 and included 3488 miles of pipe line and 469,320 hp in compressor units. These facilities are designed to add more than 2¼ billion cubic feet of daily delivery capacity to the individual pipe line systems in the United States.

Since February 7, 1942 (the date when the certificate provisions of the Natural Gas Act became effective), the FPC has authorized construction and operation of a total of nearly 48,000 miles of pipe lines and more than 3,400,000 hp in compressor units at a total estimated cost of more than $3,337,000,000. The facilities authorized since 1942 are designed to add more than 18 billion cubic feet of daily delivery capacity to the nation's individual pipe line systems.

These are the basic facts concerning Federal Power Commission certificates of public convenience and necessity granted between July 1, 1952, and December 31, 1952, and authorizing estimated construction of $700,000 or more per project:

Applicant	Description of construction	Estimated cost
United Natural Gas Company	Construction and operation of 28 miles of 6-in. and 12-in. compressor station connections and lateral pipe lines in Pennsylvania.	$ 919,000
Montana-Dakota Utilities Company	Construction and operation of a 2640-hp compressor station in the Black Hills area, South Dakota.	$ 752,927
Pacific Gas and Electric Company	Construction and operation of 51 miles of miscellaneous 12-in. to 20-in. loop and lateral pipe lines in California.	$ 1,979,000
Arkansas-Missouri Power Company	Construction and operation of a system of 140 miles of miscellaneous 2-in. to 10-in. pipe line laterals in Missouri and Arkansas from two connections with Texas Eastern Transmission Corporation near Campbell, Missouri.	$ 2,050,769
Texas Gas Transmission Corp.	Construction and operation of 408 miles of 26-in. loop pipe lines in segments on applicant's existing system between Louisiana and Kentucky and additional compressor units in new and existing stations aggregating 26,860-hp in Louisiana, Tennessee, Indiana and Kentucky.	$33,752,705
United Gas Pipe Line Company	Construction and operation of additional compressor units in new and existing main line stations aggregating 21,280-hp in Louisiana and Mississippi.	$ 5,764,396
Hope Natural Gas Company	Construction and operation of 33 miles of 8-in. to 12-in. lateral supply lines to applicant's system in West Virginia from Buchanan County, Virginia.	$ 1,165,080
Mississippi River Fuel Corporation	Construction and operation of 109 miles of 10-in. to 18-in. lateral supply pipe lines and a 200-hp field compressor station in Woodlawn and Waskom gas fields in Texas.	$ 4,958,041
Mississippi River Fuel Corporation	Construction and operation of an additional 5720-hp in two existing compressor stations in Arkansas and transfer compressor units from Perryville, Louisiana stations to new and existing stations in Arkansas and Missouri.	$ 2,357,132
Southern Natural Gas Company	Construction and operation of 20 miles of 8-in. gas supply line from Millhaven gas field to applicant's facilities in Louisiana and 19,450-hp in new compressor stations on applicant's existing system in Mississippi and Alabama.	$ 6,405,000
Natural Gas Storage Company of Illinois	Construction and operation of 17 miles of 30-in. pipe line connecting applicant's proposed new Herscher storage area to system of Texas Illinois Natural Gas Pipeline Company, 9 miles of miscellaneous field lines and a 10,000-hp storage field compressor station in Illinois.	$17,000,000
Mountain Fuel Supply Company	Construction and operation of a 2640-hp compressor station on applicant's system in Vinta County, Wyoming.	$ 772,000
MidSouth Gas Company	Construction and operation of 191 miles of miscellaneous 3-in. to 8-in. transmission and lateral pipe lines in Arkansas.	$ 3,624,200
Tennessee Gas Transmission Co.	Construction and operation of a 2640-hp compressor station in Carthage field, Panola County, Texas.	$ 880,000
Southern Natural Gas Company	Construction and operation of a 3300-hp field compressor station in Logansport gas field, Louisiana.	$ 1,021,500
Public Service Electric and Gas Company	Construction and operation of 16 miles of 10-in. to 16-in. lateral pipe lines from a connection with Texas Eastern Transmission Corporation near Linden, New Jersey to applicant's facilities in Harrison, New Jersey.	$ 4,200,000
Southern Natural Gas Company	Construction and operation of 327 miles of 8-in. to 24-in. lateral supply pipe lines in Louisiana and Mississippi gas fields and additional compressor units in new and existing stations in Louisiana and Mississippi aggregating 8700-hp.	$32,518,500
East Tennessee Natural Gas Co.	Construction and operation of 100 miles of 16-in. transmission line from Knoxville to a point near Kingsport, Tennessee, and 58 miles of 4-in. to 12-in. lateral pipe lines.	$ 5,784,608
Cities Service Gas Company	Construction and operation of additional compressor units of 4800-hp in the existing Greensburg station, Kiowa County, Kansas and 6600 hp compressor units in a new station (Hesston), Harvey County, Kansas.	$ 2,781,000
New York State Natural Gas Corp.	Construction and operation of 18 miles of 16-in. supply transmission pipe line from Driftwood Gas Field, Cameron County, Pennsylvania to applicant's facilities in Clinton, County, Pennsylvania.	$ 814,860
Texas Eastern Transmission Corp.	Construction and operation of 315 miles of 24-in. transmission pipe line from a connection with Wilcox Trend Gathering System, Inc., in Lavaca County, Texas to applicant's system in Bienville Parish, Louisiana.	$23,283,540
Wilcox Trend Gathering System, Incorporated	Construction and operation of 157 miles of 14-in. and 16-in. transmission pipe lines from gas fields in South Texas to connect with Texas Eastern Transmission Corporation in Lavaca County, Texas, 58 miles of 3-in. to 6-in. supply lateral pipe lines and a 2200-hp compressor station in South Texas.	$10,500,000
Panhandle Eastern Pipe Line Company	Construction and operation of 23 miles of 6-in. to 24-in. lateral loop pipe lines on Peoria and Lincoln, Illinois laterals and a 330-hp compressor station on the Galesburg and Canton, Illinois laterals.	$ 1,009,000

Decision Becomes Final For Iowa Construction

A decision by the Federal Power Commission's chief presiding examiner authorizing Iowa-Illinois Gas and Electric Company, of Davenport, Iowa, to construct 22 miles of natural gas pipe line and to continue the operation of other facilities, all in Iowa, has become effective as the final decision and order of the commission.

The decision was filed by Chief Examiner Frank A. Hampton on January 5. As no exceptions were filed or review initiated by the Commission, the decision became effective February 5 in conformity with the FPC's Rules of Practice and Procedure.

First application (G-1899) was filed in connection with continued operation of 23 miles of 4-in. duplicate transmission line serving the company's Ottumwa district, and 17 miles of 10-in. duplicate line serving its Davenport district. The other application (G-2012) involves construction of 22 miles of pipe line connecting with Natural Gas Pipeline Company of America's system in Mahaska County and extending to a point in Ottumwa County.

Total estimated cost of the facilities covered by the two applications is approximately $1,152,642, including $500,000 for the 22 miles of new pipe line.

General Petroleum to Lay Loop to San Ardo Line

General Petroleum's famous "persuasive pipe line" at San Ardo, California, is going to be more "persuasive" than ever soon.

George Supple, General Petroleum's vice president and director of pipe lines, has announced that the carrying capacity of the 40-mile San Ardo-Estero Bay pipe line is being increased to 30,000 bbl of crude oil daily. The $500,000 project will be completed in early spring, depending on weather conditions.

Original 40-mile line went into operation in July, 1951, to carry 18,000 bbl of oil daily from the then idle San Ardo oil field near Paso Robles, California, to a marine loading station at Estero Bay. Because of the steel shortage, pipe for the line was obtained by salvaging an unused line in the Mojave Desert.

Unique engineering characteristics of the line "persuade" the heavy, sticky, but valuable San Ardo oil to be pumped through the pipe line. General Petroleum pipe line experts figured out ways to mix the San Ardo crude oil with small quantities of a lighter petroleum product, then to heat the mixture to increase its "flowability" enough so it could then be pumped through a pipe line.

Having an efficient transportation medium available made the full-scale production of oil from the field possible. Since then production in the field has been to the full capacity of the pipe line.

Capacity was raised once previously in the summer of 1952 by adding a 30,000-ft loop. This enabled the line to carry 25,000 bbl of crude oil daily.

Next expansion project will add three more loops of 10-in. pipe with a total length of 69,300 ft. New heaters at each of the line's three pumping stations will, with the loops, enable the line to transport a total of 30,000 bbl daily.

Pipe for the three new loops will be laid by J. C. Lackey, Taft, California, pipe laying contractor. Boiler installations are being made by Oilfield Construction Company, Bakersfield. Much of the accessory work is being done by General Petroleum crews.

General Petroleum purchased an interest in the San Ardo field in April, 1952, and now has 195 producing wells in the field.

Gas Companies File Revised Applications

Permian Basin Pipeline Company, of Chicago, Illinois, and Northern Natural Gas Company, of Omaha, Nebraska, have submitted revised plans to the Federal Power Commission in connection with their proposals for Permian to build a pipe line system in Texas and New Mexico for the transportation of 300,000,000 cu ft of natural gas a day, and for Northern to increase its system capacity for the receipt of this same amount of gas.

Amended applications filed by the two companies reduce the amount of construction and the cost of both projects, but provide for the delivery of the same volumes of gas as originally proposed.

Permian now plans to construct a total of 163 miles of pipe line and 66,000 hp in compressor units in Texas and New Mexico at a total estimated cost of $40,269,000. The amended application eliminates the construction of, among other things, approximately 245 miles of pipe line proposed in the original application, extending from a point in Lea County, New Mexico, to a connection with Northern's system in Carson County, Texas.

Under the new proposal, Permian will deliver the entire volumes of gas to El Paso Natural Gas Company, of El Paso, Texas, at an interconnection in Yoakum County, Texas, and El Paso will then deliver the same quantities of gas back to Permian at a point in Moore County, Texas. Permian will deliver this gas to Northern at Dumas, Texas.

Permian's project as originally proposed included about 384 miles of pipe line and 74,360 hp in compressor stations. The cost of these facilities was estimated at $58,180,000.

Northern's amended application includes the proposed construction of about 425 miles of main pipe line, 62,400 hp in compressor capacity, and numerous branch lines and branch line additions. Estimated cost is $66,248,000. The company originally had proposed to build about 440 miles of main pipe line, and 73,600 hp in compressor capacity at an estimated cost of $69,826,000.

Both the Permian and Northern projects are to be carried out over a 2-year period, with 200,000,000 cu ft of gas a day to be delivered the first year and the full 300,000,000 cu ft a day the second year. These same volumes of gas would be delivered to and by El Paso in the first and second years, respectively.

Additional Hearings on New England Gas Service

The Federal Power Commission has consolidated four additional applications with the proceedings now in progress involving competitive proposals for natural gas service in New England.

The additional applications include (1) a joint request by Tennessee Gas Transmission Company, of Houston, Texas, and Niagara Gas Transmission, Ltd., of Toronto, Canada, for authority to export gas to Canada; (2) a request by Tennessee for a recommendation for a Presidential Permit covering facilities at the U. S.-Canadian border to export the gas, (3) an application by Tennessee for an FPC certificate for pipe line facilities in the United States to enable it to transport the additional gas for export, and (4) a proposal by Tennessee to increase deliveries of natural gas to its subsidiary, Northeastern Gas Transmission Company, of Springfield, Massachusetts.

Hearings on these four applications will begin following completion of all cross-examination in the New England gas hearings, which began last November 25 and are still in progress in Washington, D. C. These hearings involve applications by Northeastern; Algonquin Gas Transmission Company, of Boston, Massachusetts; Texas Eastern Transmission Corporation, of Shreveport, Louisiana, (which would supply gas to Algonquin); and several New England gas distributing companies. These applications are before the FPC for a determination of whether any of the applicants should be authorized to serve certain New England markets previously granted to Algonquin.

Date Set for Hearing On Station Application

Federal Power Commission has ordered a hearing to begin March 2 in Washington, D. C., on an application by Arkansas Louisiana Gas Company, of Shreveport, Louisiana, involving the construction and operation of a 7500-hp natural gas compressor station and 6 miles of 12-in. lateral pipe line in Arkansas.

Temporary authorization for construction of the compressor station, in Clark County, Arkansas, was granted by the commission last November 10. The station, estimated to cost $2,147,470, is designed to make available substantially greater volumes of gas to existing customers in central Arkansas.

The 6 miles of 12-in. lateral line would loop an existing line extending from the company's main line at Perla, Arkansas, to the Lake Catherine Electric Generating Station of Arkansas Power and Light Company. Estimated cost of the line is $205,646.

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Projects

Lone Star Constructing Underground Gas Storage

Construction of facilities for underground storage of natural gas in the depleted oil and gas field near View in Taylor County, Texas, is under way by Lone Star Gas Company. Lone Star expects to start injecting gas into the reservoir not later than May 1.

In addition to strengthening the gas supply for consumers in a wide area, the underground storage project will provide a more stable market for gas produced in West Texas, it is pointed out by officials of the company at Dallas. Total storage capacity of the reservoir is in excess of 2,000,000,000 cu ft. A 440-hp compressor is being installed with capacity to inject approximately 5,000,000 cu ft of gas a day into the reservoir. Injection will be through four wells in the View field. The compressor station, injection and withdrawal lines, and other facilities will cost $215,000.

Gas for storage will come primarily from fields in Scurry, Coke, Schleicher, Sutton, Runnels, and other West Texas counties, with delivery through Lone Star's interconnected pipe line network.

The company anticipates injecting gas in the spring, summer, and fall months when consumption is relatively low. The View field is desirable as a storage reservoir because it is conveniently situated with respect to Lone Star's transmission facilities, and also because the company now operates a gas gathering system in the field and had purchased gas from the field for a number of years prior to its depletion.

View compressor station is to be erected on a 300 by 400-ft fenced plant site. It will be attended and serviced by members of the operating crew from Lone Star's main line compressor station, situated about two miles west of Abilene. Through automatic instruments, the compressor engine will be protected by limit controls in case of oil failure, excessive temperatures, or excessive pressures.

Engine, pipe and fittings, and separate heat exchangers for cooling gas, oil, and water were assembled as a package unit at Abilene by Lone Star personnel. Unit will be trucked overland to the plant site.

FPC Allows Altering Of Approval Facilities

A decision by Federal Power Commission Presiding Examiner Francis L. Hall, authorizing Kansas-Nebraska Natural Gas Company, Inc., of Phillipsburg, Kansas, to alter natural gas pipe line facilities has become effective.

Certificate authorizes the Kansas company to construct 3 miles of 2⅜-in. pipe in Hall County, Nebraska, instead of 8 miles of the same size pipe as authorized in a 1946 commission order; to install four 500-hp units instead of one 2000-hp unit at its new Holcomb, Kansas, compressor station as authorized in February, 1951, and to eliminate authorization in the 1951 order to serve Stanton, Nebraska, which will now be served by a substitute route.

To Spend $11,264,000 on Transmission Lines

Expenditures that will give a boost to business and industrial growth while adding to the Lone Star Gas Company's resources in behalf of natural gas supply and conservation are contained in the organization's 1953 budget of $28,038,000 for enlargement and expansion of customer service and facilities. The expansion budget, announced by President D. A. Hulcy, was approved by Lone Star directors at recent meeting in Dallas, Texas.

Money will be applied throughout Lone Star's territory, which is now serving approximately 655,000 customers in company owned and operated distribution systems in 420 cities and towns in Texas and Oklahoma.

"This year's budget for expansion and additions to physical properties," said Hulcy, "represent a substantial segment of a continuing multi-million dollar program dedicated to acquiring additional gas supplies, conservation of natural petroleum resources, and better customer service facilities.

"During the past eight years our expansion program has called for more than $136,000,000 in new money. The money represents current, planned, and completed projects benefiting customers, royalty owners, and producers in our vast operating area."

Hulcy pointed out that shortages of steel and other factors could affect the expansion program to some extent, but he expressed "confidence in Lone Star's ability to meet requirements in our operating territory under limitations which might stem from the national defense program."

The Lone Star president stated that the $28,038,000 will go toward additional gathering and transmission pipe lines, construction and enlargement of gasoline and compressor station facilities, the drilling of oil and gas wells and acquiring of leases, development of new gas fields, transportation and construction equipment, new office and warehouse buildings, extensions to present local distribution systems, and numerous other items supporting customer service. Specific projects were not contained in Hulcy's announcement covering the 1953 construction budget.

Expenditures are divided as follows: Transmission division $11,264,000; Lone Star Producing Company, (wholly owned subsidiary of Lone Star Gas Company) $7,043,000; the General Division of Distribution (comprising about 360 cities and towns in Texas and Oklahoma) $3,244,000; The Dallas Division of Distribution (serving Greater Dallas area) $3,325,000; and the Fort Worth Division of Distribution (Fort Worth and forty other points) $3,162,000.

Substantial portion of the $11,264,000 set aside for transmission division of Lone Star Gas Company will go toward additional gas delivery facilities to meet the requirements of customer service throughout the 420 local distribution systems. Major expenditures under the Lone Star Producing Company's $7,043,000 will be devoted to the acquisition of leases and the drilling of wells. The remaining $9,731,000 for the three distribution divisions will be applied to new mains, service lines, meters, liquefied petroleum gas service facilities, supplies and improvements, and replacement of distribution lines.

New Volume Issued FPC Opinions and Decisions

Issuance of Volume 9 of the "Federal Power Commission Reports," which contains opinions and decisions for the calendar year 1950, have been announced by FPC.

With the publication of the new volume, all opinions and decisions issued by the FPC between January 1, 1931, and December 31, 1950, are available in the Federal Power Commission reports.

Volume 9 includes all formal opinions issued by the commission in 1950, intermediate decisions that have become final, and an appendix of selected orders in the nature of opinions. The publication contains index-digests of the opinions, decisions and orders, and its tables includes cases, statutes, and rules.

The new volume contains 1430 pages and is buckram bound. Copies may be obtained from the Publications Division, Federal Power Commission, Washington 25, D. C., at $4 per copy. The order number is FPC A-43.

Trans-Northwest Applies for Pipe Line Permit

Trans-Northwest Gas, Inc., of Spokane, Washington, which already has asked the Federal Power Commission for authority to import and export natural gas from and to Canada, has now filed an application requesting an FPC certificate for the construction and operation of a pipe line system to serve markets in eastern Washington and northern Idaho.

The proposed system, estimated to cost $19,765,480, would be used to import natural gas from Canada to serve various market areas, including Spokane, Ephrate, Moses Lake, Ohewalah, Colville, and the Atomic Energy Commission's plant at Hanford, all in Washington; and Coeur d'Alene, Kellogg, and Wallace, in Idaho. The company also proposes to export natural gas back into Canada for service to Trail, British Columbia.

Trans-Northwest would purchase its supply of gas from Westcoast Transmission Company, Ltd., at a point on the U. S.-Canadian border near Osoyoos, British Columbia, and would sell gas by export to Inland Natural Gas Co., Ltd., near Boundary, Stevens County, Washington. Westcoast Transmission would transport the gas from reserves in the northern areas of Alberta and British Columbia.

Application says that the facilities for importing gas would have a capacity of about 105,000,000 cu ft of gas a day, whereas the export facilities would have a capacity of 10,000,000 cu ft a day.

With the PIPE LINE CONTRACTORS

Williams Brothers Company, 324 National Bank of Tulsa Building, Tulsa, Oklahoma, has under construction approximately 75 miles of 24-in. pipe line for Texas Eastern Transmission Corporation, extending from Corrigan to Center, Texas. The field office is at Lufkin, Texas. O. R. Mitchell is superintendent and W. O. Lindsey assistant superintendent.

Work began recently on approximately 85 miles of 12-in. for Sinclair Pipe Line Company between Port Arthur and Pasadena, Texas. The field office is at Channelview. "Red" Graves is superintendent and Sam Davis office manager.

The contractor also is doing city distribution work at Chamblee, Georgia, for the Atlanta Gas Light Compnay. H. W. Franks is superintendent and J. E. Breedlove office manager.

H. C. Price Co., Pipeline Division, P. O. Box 1111, Bartlesville, Oklahoma, has the general contract covering construction of approximately 363 miles of 26-in. high pressure natural gas loop lines for Texas Gas Transmission Corporation from east bank of Mississippi River near Greenville, Mississippi, to Jeffersontown Station, Kentucky, a few miles east of Louisville, 42 miles remaining to be completed when the job was shut down for the winter. This work will be resumed about April 1.

Also the general contract covering construction of approximately 200.4 miles of loop and new lines for Southern Natural Gas Company in Mississippi, Alabama, and Georgia; 16.6 miles of loop lines completed in 1952.

All work has been shut down until spring. Winter headquarters for spreads are as follows:

Spread One, Princeton, Kentucky, General Delivery, Telephone 2083: G. A. Reutzel, superintendent; W. E. Yount, office manager; J. H. Ingram, equipment foreman; K. N. Adkins, road crossing; J. A. Hairston, right-of-way; Lloyd J. Loncarich, ditch; H. C. Morrison, pipe; J. C. Anderson, bending; R. W. Orr, welding; S. J. Wood, coating; Athel Bell, lower-in, and T. E. Walker, cleanup.

Spread Two, St. Mathews, Kentucky, General Delivery, Telephone Taylor 6140 (Louisville): R. L. Ezell, superintendent; W. R. Crego, office manager; Tommy Stammer, equipment foreman; Cleo Robertson, road crossing; J. D. White, right-of-way; W. H. Olrich, ditch; J. H. Latham, bending; Delbert Shivel, pipe; J. H. Riley, welding; J. B. Northcutt, coating; C. W. Sisco, lower-in, and S. L. Price, cleanup.

Spread Three, Halls, Tennessee, General Delivery, Telephone 6321: C. E. Shivel, superintendent; D. H. Johnston, office manager; Boyd Danner, equipment foreman; C. F. Jones, right-of-way; R. H. Edwards, right-of-way; Ray Drewell, ditch; R. E. Carriker, pipe; John Stokes, welding; Henry Hill, coating; Bill Muchanan, lower-in, and Paul McCormick, cleanup.

Spread Four, Oxford, Alabama, General Delivery, Telephone 257: C. R. Ice, superintendent; G. A. Harvey, office manager; Jesse Cash and W. O. Elliott, right-of-way foremen; E. W. Whisenant, ditch; Forest Loinette, bending; W. T. Dickerson, pipe; L. O. Reutzel, welding; N. D. Adams, coating; J. C. Rich, lower-in, and J. E. Hamilton, cleanup.

Ray L. Smith and Son, Inc., Hazlett Building, El Dorado, Kansas, has completed 20 miles of 12, 20, and 30-in. pipe line for Natural Gas Storage Company of Illinois between Herscher and Dwight, Illinois, and are now working on a gathering system and metering station. This phase of the project, which is for underground storage of natural gas, is scheduled for completion about March 25, depending on the receipt of scarce materials for the metering station. These are the key personnel: Dewey (Greaseball) Whitworth, superintendent; D. L. Marley, office manager; H. H. Lochead, material man; W. B. Wakefield, welding foreman; Guy Whitworth, clean-up foreman; John S. Funk, instrument man; P. W. McCullough and N. H. Utermoehlen, mechanics.

Anderson Brothers Corporation, 6300 Navigation Boulevard, Houston, Texas, will not begin construction until in May or June on the 190-mile section of 30-in. pipe between Ironwood and Cook, Michigan, for Lakehead Pipe Line Company. Claude Wilson will be project manager and Aldress Kilgore and Rusty Killingsworth spread superintendents.

Work is in progress on 80 miles of 24-in. for the Texas Eastern Transmission Corporation from Groveton to Waller, Texas. Dick Leonard is superintendent and W. W. Kirk office manager at Groveton. At Conroe, Bob Magee is super and Dick Bond office manager.

Comstock Midwestern, Ltd., 206 Laird Drive N., Leaside, Ontario, Canada, is awaiting spring weather to resume construction work on the Trans Mountain Oil Pipe Line Company project. This will probably be the early part of April. In all, this contractor will lay 472 miles of 24-in. between Edmonton, Alberta, and Vancouver, British Columbia. The central project office is at 3390 Kingshighway, Vancouver. When work is resumed three spreads will be utilized.

L. E. Farley, Inc., 2609 Sunset Boulevard, Houston, Texas, has been delayed in starting the 64 miles of 16-in. oil line contracted with Interstate Oil Pipe Line Company because of pipe. The line will be laid between Morgan City and Baton Rouge, Louisiana, with the field office at Plaquemine. Doc Berton is superintendent and Fred Hudson office manager.

O. R. Burden Construction Corporation, 6702 East 21st Street, Tulsa, Oklahoma, has one spread still at work on the Standard Oil Company of Indiana project, two spreads having completed their sections of line during February. The spread under Floyd Lewis at Centerville, Iowa, has a few miles to go. In all, Burden will lay 186 miles of this 12-in. products pipe line, the section from Sugar Creek, Missouri, to Dubuque, Iowa.

For Humble Pipe Line Company, 31 miles of 16-in. lay and 50 miles of 8-in. takeup is being done between Hawkins and Longview in East Texas. The field office is at Gladewater. R. L. Jones is superintendent, Ben Mapes assistant superintendent, and Bill Robinson office manager.

Associated Pipe Line Contractors, Inc., 3272 Westheimer Road, Houston, Texas, is underway with 80 miles of 24-in. between Waller and Provident City, Texas, for Texas Eastern Transmission Corporation. The field office is at Eagle Lake. Jim E. Andrews is superintendent and Buck Johnson office manager.

Approximately 65 miles of 20-in. pipe is being laid from Sour Lake, Texas, to Erath, Louisiana, for the Cities Service Pipe Line Company. Field headquarters are at Sulphur, Louisiana, with W. A. Briley superintendent and R. N. Cain office manager.

Mary Construction Company, Cape Girardeau, Missouri, passed the halfway mark on its job for the Indiana Farm Bureau Cooperative Association and shut down awaiting better weather. The work consists of about 180 miles of 8-in. products line from Mt. Vernon to Jolietville, Indiana. Garland Mims is super and Lewis Wiist office manager.

Engineers Limited Pipeline Company, 225 Bush Street, San Francisco, California, is laying 84 miles of 34-in. loops to the main line of Pacific Gas and Electric Company between Topock, Arizona, and Milpitas, California. Work began the middle of January. Louis Robertson is superintendent and Bob Wiley office manager. The field office is now at Barstow, California.

Morrison Constructors, P. O. Box 3206, Austin, Texas, began pipe work the early part of February on 43 miles of 26-in. for Tennessee Gas Transmission Company, from Falfurrias to Edinburg, Texas. Field headquarters are at the latter point. Emmett Wilkerson is super and A. C. Goyne office manager.

H. B. Zachry Company, P. O. Box 2570, San Antonio, Texas, is laying approximately 157 miles of 8-in. through 16-in. pipe line in South Texas for the Wilcox Trend Gathering System, working from Cuero. D. D. Shrum is superintendent and Ray Shields office manager.

XUM

R. H. Fulton and Company, P. O. Box 1526, Lubbock, Texas, has under contract approximately 100 miles of 26-in. for Northern Natural Gas Company in Kansas and Nebraska. These are loops to the main line. There are two spreads. One has its headquarters at Beatrice, Nebraska, with A. A. Carrigan superintendent and Dave Wagner office manager. The second is at Great Bend, Kansas, where M. L. Boyd is superintendent.

A job was recently started for Pure Transportation Company, 45 miles of 8-in. in Nebraska, from Sidney to Kimball. The field office is at Sidney with Oscar Phillips superintendent and G. N. Short office manager.

A contract has been awarded this contractor by Platte Pipe Line Company to lay 91 miles of 12 and 14-in. to extend its system to serve the Byron and Oregon areas of Wyoming.

H. C. Price Co., Somastic Division, Box 1111, Bartlesville, Oklahoma, has the following jobs in progress:

East Coast Division, Bustleton, Pennsylvania:

Philadelphia Gas Works Company—Application of Somastic coating to 62,476 ft of pipe ranging in size from 6 to 30 in.

Gulf Oil Corporation—Application of Somastic coating to 52,135 ft of pipe ranging in size from 6 to 24 in. Application of Hevicote to 9300 ft of 8, 12, and 16-in. pipe.

Okonite-Callender Cable Company—Application of Somastic coating to 16,695 ft of 4 and 6-in. pipe.

Phelps Dodge Corporation—Application of Somastic coating to 12,000 ft of 5-in. pipe.

Buckeye Pipe Line Company—Application of Somastic coating to 8475 ft of pipe ranging in size from 8 to 14 in. Application of Hevicote to 3475 ft of pipe ranging in size from 8 to 14 in.

Gulf Coast Division, Harvey, Louisiana:

L. E. Farley, Inc. (For Interstate Natural Gas Company, Inc.)—Application of 9/16-in. of Somastic and 1⅝-in. Hevicote to approximately 30 miles of 16-in. pipe.

Brown and Root, Inc., 4100 Clinton Drive, Houston, Texas, have contracted to lay 194 miles of 6, 8, 12, and 20-in. line for Southern Natural Gas Company in south Louisiana, but pipe laying is not expected to get underway until about April 1. The main field office will be at Morgan City.

Midwestern Constructors, Inc., 105 North Boulder, Tulsa, Oklahoma, has contracted to lay 97 miles of 30-in. pipe line for Mackinac Pipe Line Company, Inc., from Cooks to St. Ignace, Michigan. Work is scheduled to begin May 1. The field office will be at St. Ignace. M. T. Wilhite will be general superintendent in charge and John Work spreadman. Other jobs by Midwestern are as follows:

Aluminum Ore Company, Bauxite, Arkansas: Process piping, fabrication completed; installation 95 per cent completed. Earl S. Powell, superintendent; Morris Garey, office manager, and Ralph Bray, area superintendent.

Sinclair Pipe Line Company, Independence, Kansas: Construct pump station, Quincy, Illinois, 95 per cent completed. Ray M. Johnson, superintendent, and Fred Trompler, office manager.

Install piping at Humboldt, Kansas, station, completed.

Construct pump station, Pontiac, Illinois, 85 per cent completed. Charles Malone, superintendent, and W. D. Kaufman, office manager.

Panhandle Eastern Pipe Line Company, Kansas City, Missouri: Erect finfan towers at Pleasant Hill, Illinois, completed.

West Texas Gulf Pipe Line Company: Piping for pumping station at Ranger, Texas, completed.

Reynolds Metals Reduction Plant, Gum Springs, Arkansas: Sub-contract from Aluminum Constructors Mechanical Trade, starting underground work. K. L. Kreamalmyer, superintendent.

Panama-Williams Company, 1417 Melrose Building, Houston, Texas, has been awarded a contract to construct a 16-in. products pipe line between Port Arthur, Texas, and Baton Rouge, Louisiana, a distance of 194 miles. The new line will be known as the Evangeline Products System. Work will begin about April 1. Owners are The Texas Pipe Line Company, Gulf Refining Company, and Sinclair Pipe Line Company. Texas Pipe Line will have charge of construction.

C-R-C Coating and Wrapping Division, 7825 Katy Road, Houston, is yard coating and wrapping 50 miles of 16-in. through 30-in. pipe for the El Paso Natural Gas Company. The yard is at Rankin, Texas. Jack Henry is superintendent and Whitey Hughes office manager.

Jim J. McCormick and Company, Wichita Falls, Texas, has under construction 11 miles of 6-in. and 23 miles of 8-in. in Andrews County, Texas, for Magnolia Pipe Line Company. The field office is at Andrews. J. C. McKnight is superintendent and Howard Smith office manager.

Houston Contracting Company, Ltd., 2707 Ferndale Place, Houston, Texas, has the following construction work under contract:

Approximately 190 miles of 24-in. crude oil line for Rancho Pipe Line Company from Pasadena, Texas, west to Cedar Valley, about 20 miles west of Austin. E. C. Norris, superintendent; R. E. Thornton, assistant superintendent; R. J. Axsom, field office manager; headquarters, Bastrop, Texas. Expect to complete job by March 1.

Approximately 40 miles of 16-in. natural gas line for Houston Pipe Line Company from vicinity of Edna, Texas, to the Tom O'Connor gas field. F. A. Silar, superintendent; L. F. Redfearn, field office manager; headquarters, Victoria, Texas. Pipe laying started the middle of February.

Approximately 50 miles of 30-in. natural gas line for Tennessee Gas Transmission Company in the vicinity of Sinton and El Campo, Texas. First headquarters are at Sinton, Texas; W. H. Hayes, superintendent; M. L. Thompson, assistant superintendent; J. B. Stoddard, field office manager. Pipe laying began in February.

Approximately 525 miles of 24-in., 20-in., 16-in., and 14-in. natural gas lines for Southern Natural Gas Company in Georgia, Alabama, Mississippi, and Louisiana. Work to start early in March. Personnel and locations to be announced later.

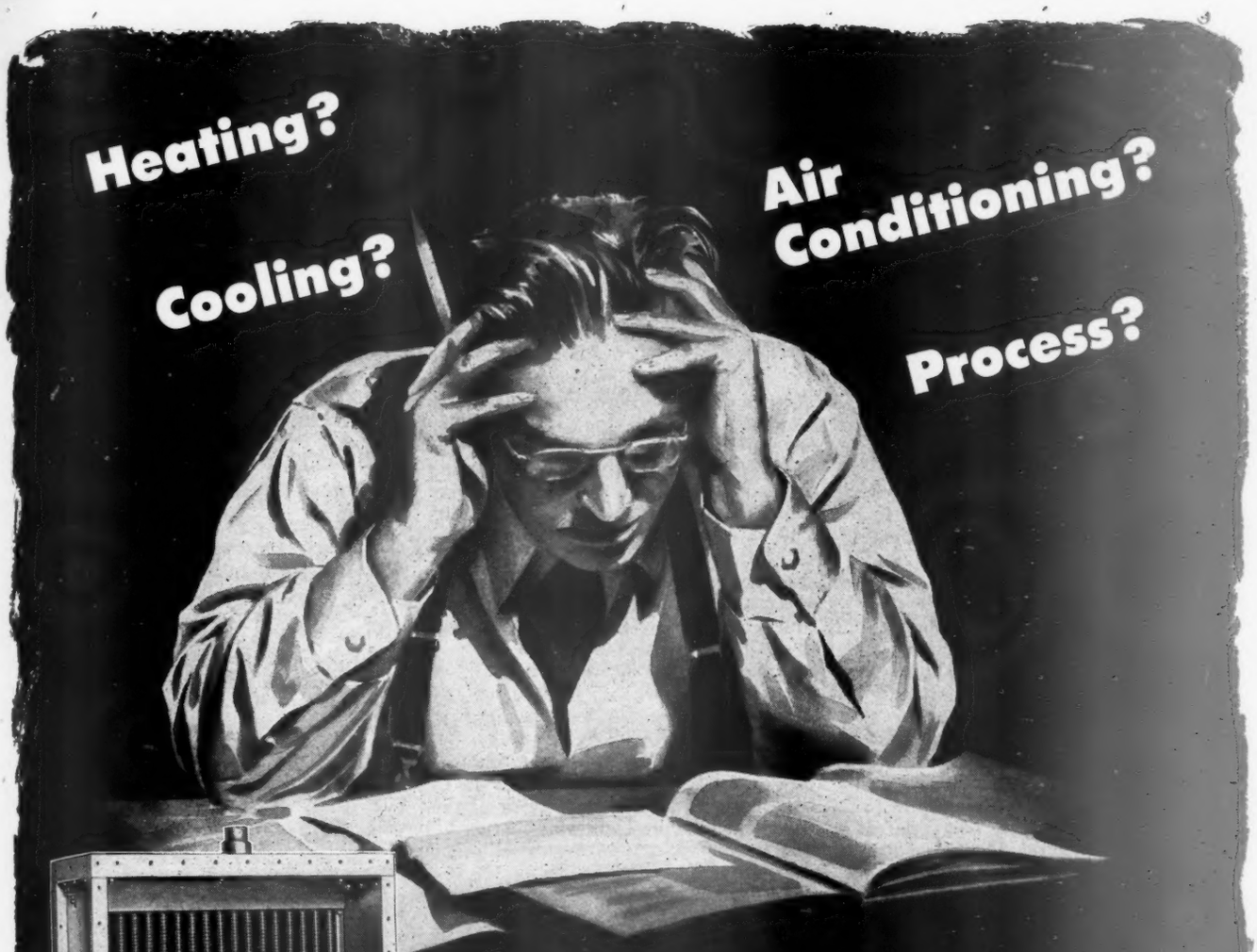
Mannix, Ltd., 332 Seventh Avenue West, Calgary, Alberta, Canada, which has the contract for 224 miles of 24-in. on the Trans Mountain Oil Pipe Line Company project, is doing no pipe work until the weather opens up. It has been possible, however, to do some right-of-way clearing during the cold months. The section of line being constructed by this company is between Blue River and Coquihalla Pass. The operating office is at 412 Victoria Street, Kamloops, British Columbia. C. P. Baker is project manager.

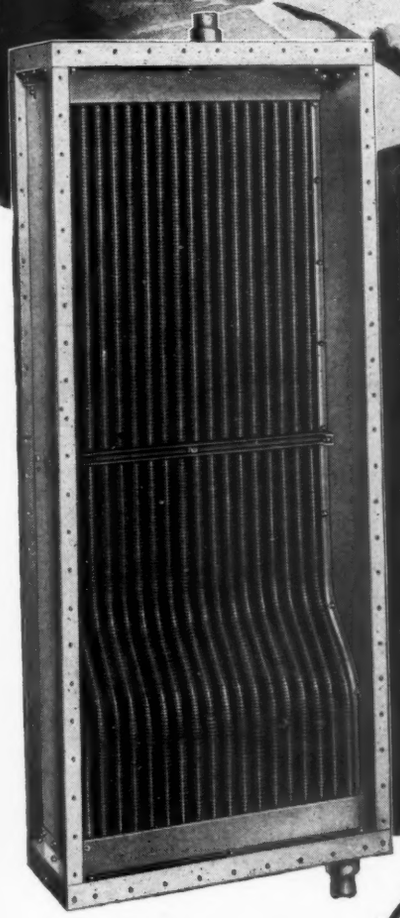
Trojan Construction Company, 1416½ North Robinson, Oklahoma City, Oklahoma, is laying 80 miles of 24-in. pipe line for Texas Eastern Transmission Corporation between Center, Texas, and Castor, Louisiana. The job is scheduled for completion about April 15. "Swede" Tillotson is superintendent and Vernon Yeager office manager. The field office is at Center.

Dunn Brothers, 801 Mercantile Securities Building, Dallas, Texas, are hauling and stringing an undetermined amount of pipe in Texas, New Mexico, and Arizona for the El Paso Natural Gas Company. An undetermined amount of pipe is being hauled from Houston and strung in the vicinity of El Campo, Texas, for Tennessee Gas Transmission Company. For Magnolia Pipe Line Company, approximately 30 miles of pipe is being hauled from Oklahoma to Andrews, Texas.

Delta Pipe Line Construction Company, Cushing, Oklahoma, has been awarded a contract by Interstate Oil Pipe Line Company to lay 14 miles of 8-in. trunk pipe line in Caddo and Bossier parishes, Louisiana. The line will connect with Interstate's Ida-Moore station trunk line about 3 miles south of Dixie and extend southeast to a connection with the company's existing Weller-Moore line 6 miles east of Bossier City. Construction is scheduled to begin March 2 with completion expected before March 31. The new line will provide re-routing of the system that transports oil from southeast Arkansas and northwest Louisiana fields into the Shreveport-Baton Rouge mainline.

Texas Engineering Construction Company, 3502 Lawrence Street, Corpus Christi, Texas, is laying about 22 miles of 8 and 14-in. pipe for Lummis Corporation in the Corpus Christi area.





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Charge That Imports Are Supplanting Domestic Oil Production Aired at Texas Hearing

At what point does "supplementing" become "supplanting"?

That was the top question before the Texas Railroad Commission at its hearing February 18. Involved were logistics and ethics as well as semantics. Could anybody reasonably determine the amount of imports required to supplement U. S. production without damaging domestic production? Could the importing companies, without violating the anti-trust laws, plan equitable importations and still retain a competitive field?

These are complicated problems and they cannot be solved separately.

The first and most important step toward reaching a decision was taken by the Texas Railroad Commission. It distributed a questionnaire to importing companies to determine their estimate of what should be considered ample stocks and of the amount of imports planned for 1953. (See table.)

As Chairman Ernest O. Thompson said, "The Commission has no legal control of imports, but we can point out how much oil is being imported and by whom." The data were needed also to guide the Commission in setting allowables in the chief oil-producing state in the nation.

When the 1953 imports schedule totaled 896,912 bbl* daily of crude oil and products, General Thompson said it did not seem fair, after Texas has built up a reserve daily producing ability of 600.000 bbl of oil for defense, that Texas should be confronted with the threat of having its output supplanted by foreign crude oil.

Importing companies were in essential agreement. They accepted the "expressed policy that oil imports should only supplement and not supplant U. S. domestic production." Standard of Indiana's statement added, "In our opinion, imports are now supplanting rather than supplementing domestic crude production and should be reduced."

All the companies questioned expected an increase in U. S. domestic demand with estimates of percentage gains ranging from The Atlantic Refining Company's 6.7 per cent to The Texas Company's 4.3 per cent.

None of the companies thought a steel shortage would greatly curtail drilling in 1953. Standard of California included the condition "if steel controls are removed."

Continental Oil Company stated: "At the end of 1952, according to PAD, U. S. crude oil producing capacity was 7,200,000 bbl a day and refining capacity was 7,770,000 bbl a day. Reserve producing capacity was about 700,000 bbl a day and reserve refining capacity about 800,000 bbl a day. These margins are more than sufficient to meet anticipated increases in demand in 1953. There will, therefore, be a tendency to over-produce and consequently build up excessive stocks of crude and products."

Bryan W. Payne, president of Texas Independent Producers and Royalty Owners Association, declared imports should be cut by 250.000 bbl a day.

A cut of 300,000 bbl a day in imports was called for by Charlton H. Lyons of Shreveport, Louisiana, president of the Independent Petroleum Association of America.

A cut in Texas allowables of 118,405 bbl a day was made for March, the most severe since July, and the third cut in the last four months. In July production was cut back 164,017 bbl a day. The state is now producing 3,118,751 bbl a day. Further cuts in Texas oil production were predicted by General Thompson.

*Excluding 231,000 bbl a day sold abroad to others for importation in the United States.

Crude Stocks Hit New High

The biggest gains in crude stocks since May was made at the end of the week of January 31 when the Bureau of Mines reported a total of 270,641,000 bbl a gain of 4,018,000 from the week before. One week later, February 7, however, stocks dropped to 270,182,200 bbl. Compared with the week before figures, this represents a decrease of 459,000 bbl comprising an increase of 629,000 bbl in stocks of domestic crude and a decrease of 1,088,000 bbl in stocks of foreign crude.

January 31's jump included 3,749,000 bbl in domestic oil, and when compared with year earlier, combined stocks were up 15,831,000 bbl or 6.2 per cent. Biggest rise was in crude from Oklahoma, followed by that from California, Wyoming, West Texas, and Kansas.

U. S. Oil Imports Are Up 13 Per Cent From Year Ago

Imports of oil into the United States have been running approximately 13 per cent higher than the average a year ago, API figures indicate.

Total imports for the week ended February 14 were reported at 1,056,000 bbl daily, a considerable rise from the 856,700 bbl daily reported the week before. Reason for the below 1,000,000-bbl mark, was held to be the strike that tied up Atlantic Coast shipping that week.

Week ended	Crude oil	Residual oil	Others	Total
January 17	669,000	442,900	9,700	1,121,600
January 24	537,900	465,000	.....	1,002,900
January 31	552,600	527,600	18,600	1,098,000
February 7	417,700	425,400	13,600	856,700
February 14	616,700	437,100	3,100	1,056,900

Below are exports as reported by PAD. Figures are in thousands of barrels.

	Avgas	Motor gasoline	Kerosine	Distillate	Residual	Total
December 26	47.2	75.0	29.8	65.7	65.7	247.6
January 2	27.6	54.3	....	39.5	31.0	152.4
January 9	37.0	28.7	13.7	57.3	45.0	181.7
January 16	35.5	17.3	....	42.0	32.5	127.3
4 weeks ended January 16	36.8	44.1	10.9	51.1*	35.3	178.3

Table based on Texas Railroad Commission questionnaire.

Company	Estimate of ample stocks for U.S. compared to present stocks, Barrels: Crude oil 5/1/53	Crude oil 11/1/53	Gasoline 5/1/53	Gasoline 11/1/53	Kerosene 5/1/53	Kerosene 11/1/53	Distillate 5/1/53	Distillate 11/1/53	Residual 5/1/53	Residual 11/1/53	Estimate of daily average imports for 1953: Crude oil	Products	Total imports
The Atlantic Refining Company	271	276	151	120	16	37	55	127	38	53	56,600	0	56,600
Cities Service Companies	260	260	153	120	19	34	53	123	40	50	8,518	0	8,518
Continental Oil Company	255-2 0	255-260	150-155	125-130	19-20	33-34	50-55	120-125	38-40	48-50	0	0	0
Gulf Oil Corporation	260	260	156	125	*	*	65*	150*	40	55	107,000	13,000	120,000
Humble Oil and Refining Company	†260-274	260-274	157-167	122-133	17-18	34-37	46-51	111-119	34-39	48-53	0	0	0
Phillips Petroleum Company	270	270	157	126	17	35	52	124	38	50	6,500		6,500
Shell Oil Company	265	268	155	125	18	35	52	125	40	55	0	12,198	12,198
Sinclair Oil Corporation	270	275	148-152	124-128	16-18	30-32	52-56	110-116	36-38	50-54	68,000	0	68,000
Socony-Vacuum Oil Company, Inc.	265	270	154	126	17	35	51	125	38	50	92,800	+	92,800
Standard Oil Company of California	260	260	150	125	19	34	55	125	40	45	107,000	0	107,000
Standard Oil Company (Indiana)	260	260	155	125	18	37	53	120	38	50	13,000	35,000*	48,000
Standard Oil Company (New Jersey)	260-270	260-270	150-155	123-128	18-20	35-38	50-55	125-130	35-37	49-52	98,000	103,000+	201,000
Sun Oil Company	265	275	150	125	20	35	60	120	40	55	11,096	0	11,096
The Texas Company	260	260	145	120	20	33	45	120	35	45	62,400	68,000	69,200
Eastern States Petroleum Company	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	7,000	8,000	15,000
Total											637,914	239,198	815,912
Bonded products													81,000
Total													896,912
Actual reported stocks Bureau of Mines (February 7, 1953)	270.2		152.5		22.3		78.2		45.8				

*Kerosene, light burning oils, diesel oils combined.
† Reflects stocks 4-1-53 and 10-1-53.
* Imported by Pan American Petroleum and Transport Company.
+ Bonded fuel oil not given.

PAD Tubing Allotment Is Under That Requested

Priorities assistance for the purchase of 309,372 tons of casing and tubing during the second quarter of 1953 has been granted to 1695 oil and gas operators in the United States, Deputy Petroleum Administrator J. Ed Warren announced. This tonnage, Warren pointed out, is less than a third of what was requested and is almost 150,000 tons below the actual needs of the operators as calculated by the Petroleum Administration for Defense.

PAD received requests for allocation of 1,086,724 tons of pipe from 2107 operators. Of these 412 were denied. The calculated needs of the operators whose requests were approved came to 451,514 tons.

Twelve large crude-oil pipe lines and 11 large petroleum-products lines with a total construction cost of $492,470,700 have been granted priorities assistance for the purchase of 251,306 tons of line pipe during the second quarter of 1953. In addition a number of smaller projects have been given priorities asistance by PAD for the purchase of 37,720 tons of line pipe during the second quarter.

World July Output Is Reported Below June

World crude petroleum production during July averaged 12,153,000 bbl daily, compared to 12,333,000 during June, according to the U. S. Bureau of Mines. Daily average production in the Middle East fell off by 3.8 per cent, a decline reflecting a drop of approximately 20.0 per cent in Iraq and 5.4 per cent in Saudi Arabia. In the United States, Mexico, and Venezuela, daily average rates declined slightly. Canadian production averaged 188,000 bbl daily, a new record, in July, the B of M reported.

Crude imported into western Europe averaged 1,360,000 bbl daily, compared to the June record rate of 1,488,000. The principal daily average declines in imports occurred in Italy and the United Kingdom, where the daily movements were both approximately 16.0 per cent lower than in June.

Exports of crude from the Middle East (exclusive of shipments to Bahrein) averaged 1,689,000 bbl daily, a 3.0 per cent drop from the daily rate in June. Daily average shipments from Kuwait during July reached a record 775,000 bbl. Venezuela exported crude at the rate of 1,409,000 bbl daily, a slight decline from June.

Wilshire Oil Dissolved

Ralph F. Forch, vice president and general manager of Wilshire Oil Company, Inc., announced that the directors of the company had adopted a plan of liquidation and distribution of assets for the ultimate dissolution of the company. Forch stated that as the oil producing properties of Wilshire in California and Texas are distributed to the shareholders in the liquidation proceedings, they will be operated by B-L and Associates, Inc., as operator.

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Storage Terminal Planned

Establishment of an LP-Gas storage terminal one mile west of Hutchinson, Kansas, was announced by Cities Service Oil Company. Cities Service terminal will include underground storage capacity of approximately 4,000,000 gal, some above-ground storage, and rail and truck loading and unloading facilities.

The underground storage will be washed out of the salt formation underlying the acreage just leased by Cities Service. Fresh water will be circulated to dissolve and remove the salt. The brine water will be piped to the nearby Morton Salt Company plant for disposal. Each of four caverns to be drilled will have storage capacity of 1,000,000 gal.

Brien Named Eastern Editor for The Petroleum Engineer

Eugene B. Brien has been named Eastern editor of *The Petroleum Engineer*, with offices at 52 Vanderbilt Avenue, New York City.

Former editor of the Market Surveys Department of general chemical division, Allied Chemical and Dye Corporation, Brien received his bachelor degree at Boston College and took his master's degree in political sciences from Fordham University in 1948.

In 1942 Brien joined the U. S. Army Air Corps where he was graduated from the Technical Air Inspection School, a large research center at Orlando, Florida. For almost a year he conducted physical inspections of air installations and in 1945 was promoted from corporal to second lieutenant.

Eugene B. Brien

Brien became executive secretary to the general manager of The Borden Company in Everett, Massachusetts in 1946, leaving the following year to continue his studies at Fordham University. From 1947 to 1951 he was an instructor in economics and government at Fordham, where he completed his doctoral studies in 1950. He joined Allied Chemical and Dye Corporation in 1951. In addition to his duties as editor and rewrite man for the market surveys department of the general chemical division he has been in charge of all nonlaboratory research for both synthetic organic and inorganic herbicides. About 40 per cent of his research time was spent in "live" research, namely in visiting and interviewing leading scientists in synthetic organic chemistry in both industry and government.

He also undertook management and economic surveys including break-even points, sales forecasts, industry-wide analyses of chemical products, etc.

As editor for the general chemical division, Brien was required to know the national market for industrial chemicals. In addition he had to edit and re-write reports made by members of the department. Brien has had other experience in the field of writing. In the Air Corps he was a reporter on *Brief*, the 7th Air Force publication.

The new Eastern editor will cover all phases of the oil industry in the East for *The Petroleum Engineer*.

Stanolind Fellowships

Thirteen colleges and universities have been awarded a total of 15 Stanolind Oil and Gas Company fellowships for the 1953-54 academic year. Each fellowship carries a stipend of $1500 as well as tuition and fees. Stanolind fellowhips are available to all qualified students, with selection of the fellows to be made by the respective schools in cooperation with Stanolind.

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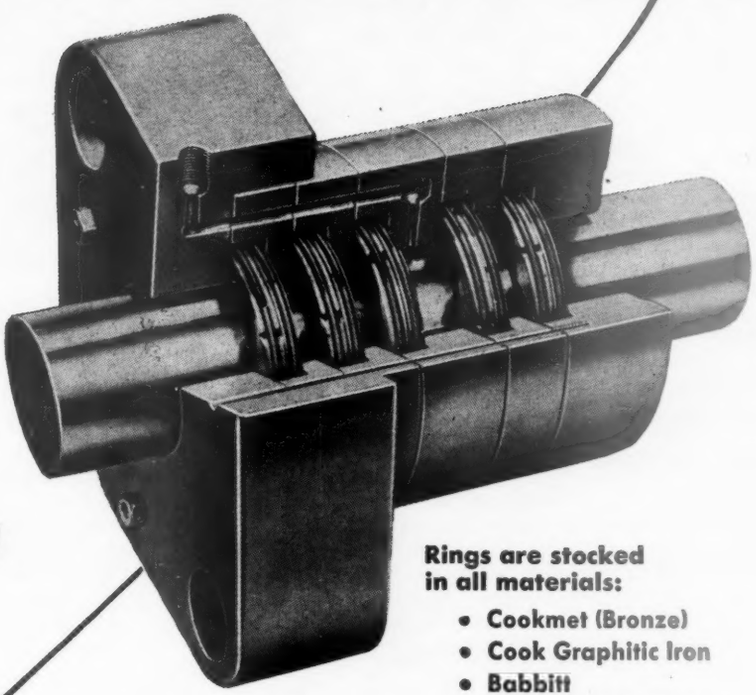

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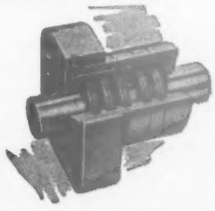

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Oil Earnings for 1952 Second Highest in History

Oil earnings in 1952 were for most firms the second highest in the history of the industry. The year before, 1951, records showed to be the highest generally, but income is expected to exceed other years. Chase National Bank, which writes a survey on 30 oil companies' income each year, reported that it expects total net income to reach $2,015,000,000, about 3.6 per cent under the $2,090,000,000 reported for 1951. Companies reported on by Chase make up about 60 per cent of the assets of the American oil industry.

This difference in incomes for the two years was not uniform, however. Phillips Petroleum, for example, reported a net income of $75,300,000, compared with $73,700,000 for 1951. Maracaibo Oil Exploration Corporation also reported a net income rise in 1952—$131,012 compared with $127,943 in 1951.

In contrast Standard Oil of New Jersey's president, Eugene Holman announced he expected 1952 earnings of the company to drop slightly lower than those reported for 1951. Wilcox Oil had a net income of $768,664 compared with $860,004 for 1951.

Studying points on the globe where invitations to the International Petroleum Exposition have been extended are William B. Way, general manager of the exposition, left, and Z. B. Hyde, chief, fairs and exhibitions section, office of international trade, U. S. Department of Commerce.

Annual Meet Date Set

The 34th annual meeting of the Texas Mid-Continent Oil and Gas Association will be held in Houston, October 6-7, at the Rice Hotel, Charles E. Simons, executive vice president, announced recently. Corbin J. Robertson, Houston, district vice president, and Houston members of the association will meet soon to make committee assignments.

Prices Begin Readjustment With Lifting of Ceiling

Oil prices have begun their period of readjustment now that they are unhampered by government controls. With the removal of price lids on oil and gasoline by the President, some prices have risen and some dropped but when final readjustment and shifting is made, general prices are not expected to be much higher to the consuming public.

The large accumulation of stocks of fuel oils has brought prices below ceiling in the Mid-Continent area and probably will do the same in the East. Although demand for petroleum production has been heavy, the refining industry has been producing more fuel oil than it can get rid of due largely to warm weather, and refiners feel that lower prices will help sell their large stocks.

Standard Oil of California has announced that it is paying from 10 to 50 cents a barrel more for its crude oil, depending on gravity. Wholesale price of motor and aviation gasolines is being raised generally, resulting in an increase in gasoline of about 2.1 cents a gallon.

Pennsylvania Grade Crude oil prices have been raised 15 cents a barrel. The first increase since December 1950 will allow for inequities in labor and material costs to producers that have existed, Joseph Seep, purchasing agent for South Penn Oil Company reported.

Russell B. Brown, general counsel of the Independent Petroleum Association of America urged that petroleum prices be increased generally to help meet costs of production that have risen from 30 to 50 per cent in the last five years. He added that a general increase in prices would not necessarily follow, but in many area adjustments are indicated.

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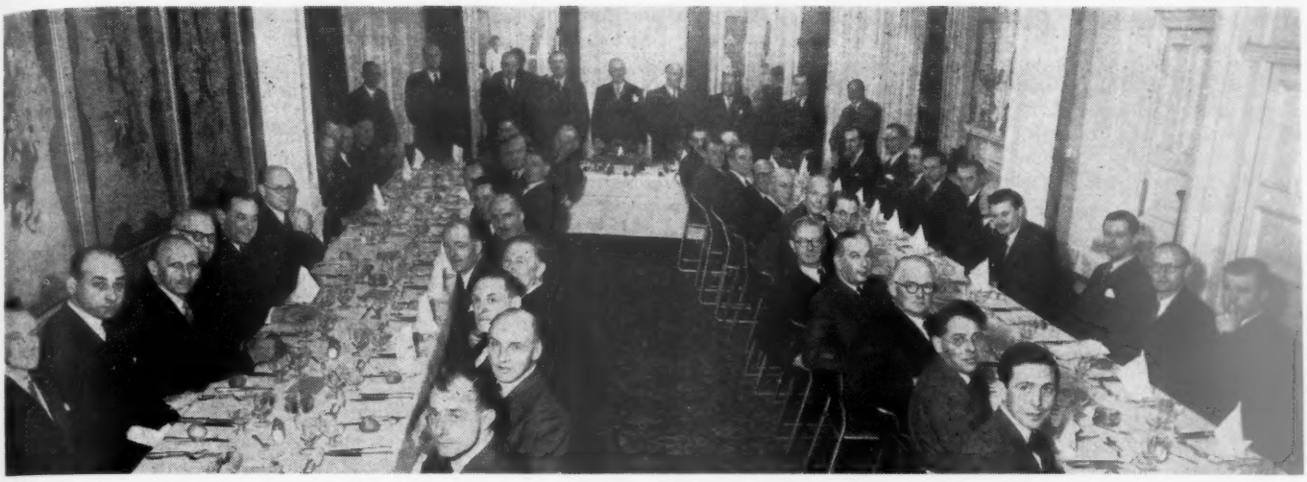

British Industrial Measuring and Control Apparatus Manufacturers' Association hold annual luncheon in London, England. This association includes companies manufacturing more than 90 per cent of industrial instruments in England.

API District Meeting Is Held in Tulsa

More than 1000 executives and technical oil men from Oklahoma, Kansas and the Texas Panhandle are expected in Tulsa, Oklahoma, on March 18-20 for the 1953 spring meeting of the Mid-Continent District American Petroleum Institute's Division of Production. General session on March 19 features addresses by J. G. Pew, vice president of Sun Oil Company, and two other nationally prominent production executives. Pew is vice chairman of the API for Production.

Old Timers to Be Noted

A "Pioneer of Pioneers" and a "Grand Old Man" for each major division of the petroleum industry will be selected for the 1953 International Petroleum Exposition in accordance with a tradition started in 1927 when John D. Rockefeller, Sr., presented such awards. The "Old Timers" Committee, headed by W. J. Sherry, independent oil producer, Tulsa, will conduct a contest to determine the honorees.

Fuel Oil Report Out

The National Petroleum Council has announced that a report of the Committee on Bunker "C" fuel oil held December 9, 1952, is now out. Report contains many tables and charts.

Desk and Derrick

Oklahoma City Desk and Derrick Club has been featured in the Sunday supplement of the *Daily Oklahoman*. Included are pictures of new officers and girls on a field trip.

San Antonio, Texas, Desk and Derrick girls have elected new officers, who were installed at a dinner in the St. Anthony Hotel recently. Annette Flinn, Oil Well Supply Division, was installed as new president.

Dr. Robert E. Wilson, chairman of Standard Indiana, spoke at the charter dinner of the new Desk and Derrick Club of Chicago, Illinois. His subject was "Progress with Petroleum."

Gas Expansion Ban Lifted

The Petroleum Administration for Defense has removed restrictions on expansion of natural gas services throughout the nation. Because defense needs of the U. S. for natural gas are now being met, PAD reported, it has rescinded its Order No. 2, which had previously required PAD approval before natural gas companies could extend service to large-volume industrial customers and house heating market.

J. Ed Warren, Deputy Petroleum Administrator, stated that the order had been originally issued to assure that defense plants received sufficient amount of gas. "Our surveys now indicate that the purpose has been fulfilled," Warren added. He warned, however, that in some parts of the country all gas supplies desired are not available, and that some natural gas companies will be unable to serve everyone who wants gas.

Taverne to Assist in Bolivian Oil Search

Dr. Nicolaas J. Taverne, a Dutch mining engineer, has left the U. S. for Bolivia where, as a United Nations technical assistance expert, he will advise on ways to expedite the development of the oil resources of the country already discovered and investigate the possibilities of extending the exploration for oil.

At the request of the Government, Taverne will work closely with the Bolivian National Petroleum Board in a study of operations related to oil production, including geological surveys, methods and equipment used in prospecting, drilling, and refining of oil, storage, distribution, and marketing of oil products, etc. Dr. Taverne, whose assignment in Bolivia is for one year, is a Doctor of Science from Delft University. He has been for many years with the Shell Oil Company in London and in The Hague.

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API Indorses NPC Policy On Imports, Foreign Oil

"Foreign oil" and "imports" principles of the National Petroleum Council's "National Oil Policy for the United States" have been endorsed formally and officially by the American Petroleum Institute.

Disclosure of the action taken by the executive committee of the Institute's board of directors was made by President Frank M. Porter. He said the endorsement places the Institute squarely behind these principles:

Participation by U. S. oil men in the development of the world's oil resources is in the interest of all nations, and is essential to this country's security;

U. S. oil men should be encouraged to develop global oil resources on equal terms with other nationals, and to work out stable agreements with foreign governments on a basis that will promote development by free enterprise methods;

U. S. government should use its diplomatic prestige and channels to reduce the political risks involved in such foreign operations, and permit U. S. oil men to operate abroad in conformity with the laws and customs of other countries;

The nation's economic welfare and security require a policy on petroleum imports that will encourage exploration and development efforts in the United States, and which will make available a maximum supply of domestic oil to meet the needs of the nation. Porter said this means that the Institute concurs with the philosophy that imports of foreign oil should be used to supplement but not displace or retard domestic production.

Endorsements of the NPC conclusions were recommended to the executive committee by the Institute's National Oil Policy Committee, which is headed by Alfred Jacobsen, president of Amerada Petroleum Corporation.

Other steps taken by the executive committee at the same meeting were:

1. A recommendation that Congress clarify the authority of the Federal Power Commission in regard to natural gas. This resolution held in part:

"The decisions of the FPC and the courts, which would subject production and gathering of natural gas and price received by the producer to control by the Commission are contrary to the intent of Congress and are preventing the movement to consumers of vast quantities of natural gas under competitive conditions.

2. A formal call on the United Nations General Assembly to reconsider a resolution endorsing the principle of nationalization without providing for idemnification for expropriated properties.

3. Agreement that the API should call upon the United States Government to withdraw from the International Labor Organization, of which it has been a member since 1934. The executive committee held that the ILO and its staff are dominated by an atmosphere hostile to the American form of government and way of life, and that its membership numbers few nations which uphold free enterprise as a worthy objective.

4. Appointment of a study committee, to work with the American Petroleum Industries Committee and others on the question of highways, and to bring forward a report with recommendations for a policy on this matter at the April board meeting.

Estimate Oil Demand Put Above Year Ago

The U. S. Bureau of Mines has set the estimated amount of domestic crude that will be consumed or exported in February at 6,420,000 bbl daily compared with 6,446,000 bbl forecast for January 1952.

On the West Coast, Reese H. Taylor, Union Oil Company of California president, estimated a record demand of 1,120,000 bbl daily will be reached in 1953, or 33.4 per cent over 1952.

Dr. Robert E. Wilson, chairman of Standard Oil Indiana, has estimated a 4 to 5 per cent increase in domestic demand for petroleum products in 1953.

Engineers Club Aids Boys

The Engineers Club of Dallas announced that it has awarded three $500 scholarships to Dallas boys for the spring and fall semesters of 1953. The awards are a part of the club's program for counselling and assisting prospective engineers. "We are happy to do our part in attempting to alleviate the acute shortage," said T. S. Bacon, chairman of the club's scholarship committee.

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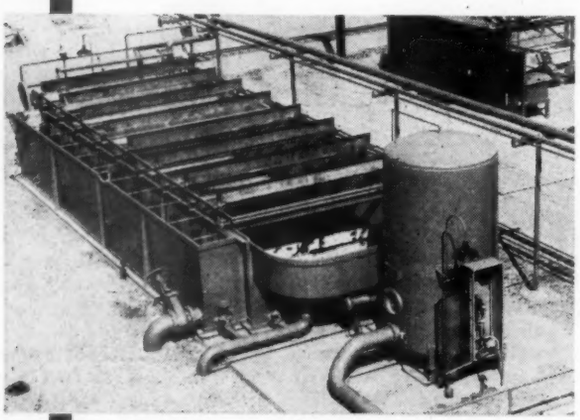
Refinery "C"	232.0	2.0
Oil-field brine "A"	40.0	5.0
Oil-field brine "B"	300 to 500	1.0 to 6.0



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British and Iran Disagreement Unsettled

The British and the Iranians seem no where nearer a solution to their quarrel over the nationalized Anglo-Iranian Oil Company than they were at the beginning. Both Iran and England seem to be waiting to see whether the Eisenhower administration will back up the plans for settlement presented by former Secretary of State Acheson. This formula called for the U. S. to advance $100,000,000 to Iran to meet immediate pressing financial problems, and in return, Iran was to agree to submit its quarrel with Britain to the International Court.

Meanwhile in Italy the Italian tanker Miriella docked at the "free zone" of Porto Marghera, Venice, to discharge its load of Iranian oil. On hand to greet the tanker were legal representatives from AIOC, who sought court action to impound the cargo.

The 5700-bbl cargo of Iranian crude oil which had been impounded in the tanker "Rose Mary" at the Red Seaport of Aden by a 7-months argument over its ownership, is now enroute to AIOC's refinery at Laverton near Melbourne, Australia. Aden Supreme Court ruled the oil belonged to Anglo-Iranian and ordered the defendants in the case to turn it over to them.

Mineral Rights Sought on All Public Lands

Senator Lester C. Hunt of Wyoming is seeking to get a bill through Congress giving the mineral rights on all public lands to the states. He compared the western states with coastal states' fight for its tidelands rights, and declared principles were the same. Hunt, a former member of the Wyoming State Land Board, added that from his own observation he had noted the more efficient manner in which the state government could handle public lands compared with the Interior Department.

If the bill becomes law it would give the states all mineral rights underlying federally owned lands except for national forests, parks, and monuments, wildlife preserves, etc.

Hunt concluded that people of the western states are "as rightfully entitled to the revenues produced from minerals under public lands in our states as are the states in coastal areas involved in the so-called tidelands issue."

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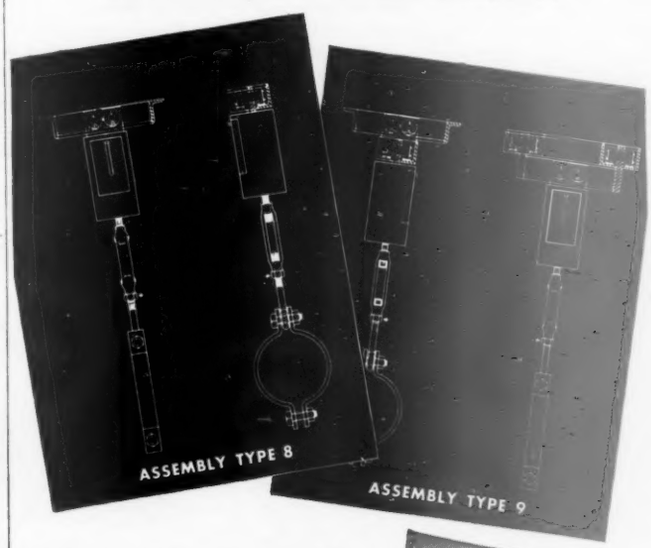

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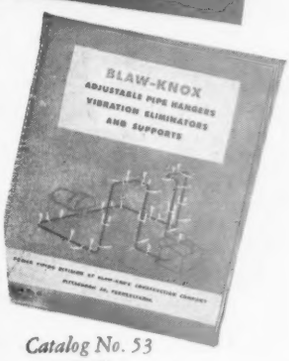

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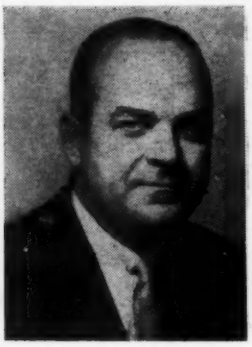
Personals

J. S. Leach



A. C. Long

W. S. S. Rodgers

H. T. Klein

J. W. Foley

J. S. Leach, president of The Texas Company, has been named chairman and chief executive officer of the company, upon retirement of **W. S. S. Rodgers,** March 1. **A. C. Long,** executive vice president, will succeed Leach as president.

Colonel Harry T. Klein, chairman of the executive committee, will retire from the company, April 1. Rodgers and Klein both are retiring in accordance with the company's compulsory retirement plan. They will remain as members of the company's board of directors and as members of the executive committee.

Leach, who began his business career in the sales department in 1916, was elected a vice president in 1938, executive vice president in 1950, and president in April, 1952. Long became associated with the company in 1930, and has served in both foreign and domestic operations of the company. He became executive vice president in 1951.

Rodgers has been with Texaco for more than 37 years. He served as president of the company from 1933 until his election as chairman of the board in 1944. Col. Klein, associated with the company for 32 years, was general counsel from 1925 to 1944, and president until his election as chairman of the executive committee in 1952.

J. W. Foley, assistant to the chairman of the board, had been elected a vice president. He will continue to serve as assistant to the chairman of the board. Foley was graduated from Texas A & M. He joined Texaco in 1932.

Albert B. Stevens, professor petroleum engineer department, Texas A & M College, has been appointed head of that department. He succeeds **Harold Vance** who is leaving the college to head the oil and gas department of the Second National Bank in Houston. Prof. Stevens holds his Bachelor of Science degree in petroleum engineering from the University of California and his Master of Science degree in petroleum engineering from the University of Southern California.

Kenneth G. Donald has been named vice president and treasurer of National Research Corporation. The position of treasurer was recently made vacant as a result of the resignation of **E. Norman Staub.** Donald is a graduate of Harvard. Class of '21, magna cum laude, as well as a graduate of the Harvard School of Business Administration, 1926.

James O. Kemm has been appointed senior representative in the Kansas-Oklahoma district of the Oil Industry Information Committee. Kemm will make his headquarters in Tulsa, Oklahoma, where he succeeds **Robert E. Featherston** who has resigned effective February 15 to devote his time to other interests. Featherston has been with the OIIC since 1947 when he opened the district office in Tulsa.

John H. Yocom has been named manager of The British American Oil Company, Ltd's. public relations department. Yocom is a graduate of the University of Toronto and is well known in the Canadian publishing field. For the past four years he has been managing editor of "Saturday Night" magazine.

J. B. Kitchen has been named division purchasing agent for the Texas-Louisiana Gulf Coast division of Stanolind Oil and Gas Company. Kitchen succeeds the late M. S. Biggs. Kitchen joined Stanolind's purchasing department in January 1943 in the general office in Tulsa. In April of that year he was made priority supervisor for the company. In June 1949 he was appointed buyer for the division, a position he held until his appointment as purchasing agent.

E. B. Stewart

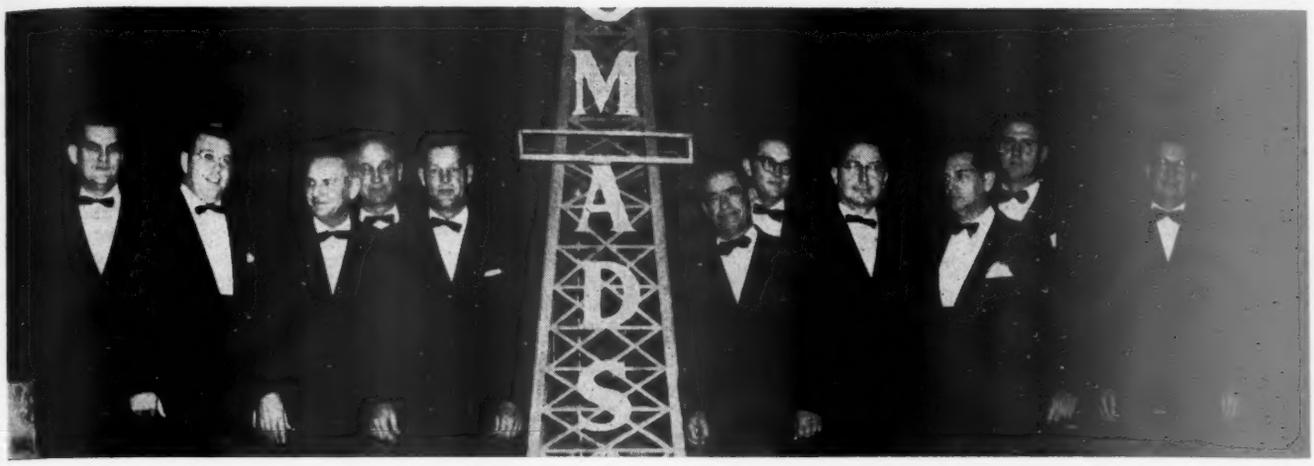
J. S. Leonard

A. L. Henderson

E. B. Stewart, district manager for Ohio Oil Company at Sidney, Nebraska, will succeed **A. L. Henderson** as Terre Haute, Indiana, division manager. Henderson retired March 1. Associated with Ohio Oil for 36 of his 46 years in the oil industry, Henderson has elected an early retirement under the company's annuity retirement plan.

J. S. Leonard, Houston division drilling superintendent, has been appointed Sidney district manager.

Guests at Houston Chapter of Nomads meet at College Inn in February were: John W. Gunn and D. G. Sawyer, Texas Petroleum Company, Bogota, Colombia; Earl Overstreet and Glenn Byers, Shell Oil Company, Houston; E. E. McGar, Shell Caribbean, Maracaibo, Venezuela; Staley Kessinger, Creole, also of Maracaibo.



New Officers of Houston Chapter of NOMADS for 1953 are H. J. Wood, regent; Ben J. Young, Joe Lyne, sergeant and deputy-sergeant-at-arms; W. O. Hedrick, assistant secretary; Ed M. Fontaine, president; E. T. Adams, assistant treasurer; W. L. Childs, Jr., treasurer; M. T. Works, secretary; R. Dowan, vice president; R. K. Franklin, regent; H. E. Estes, executive secretary.

R. D. Martin, assistant manager, crude oil coordination department of Standard Oil Company (Indiana), has been promoted to manager. **P. J. Perille,** supervisor of the crude oil supply division, succeeds Martin as assistant manager. Martin obtained his bachelor's and master's degrees at Purdue University. He joined Standard in 1946, and was made assistant manager of the crude oil coordination department in 1952.

Perille came to the company in 1944 as a chemical engineer in the research department at Whiting, Indiana. He became a supervisor in the crude oil coordination department in 1949.

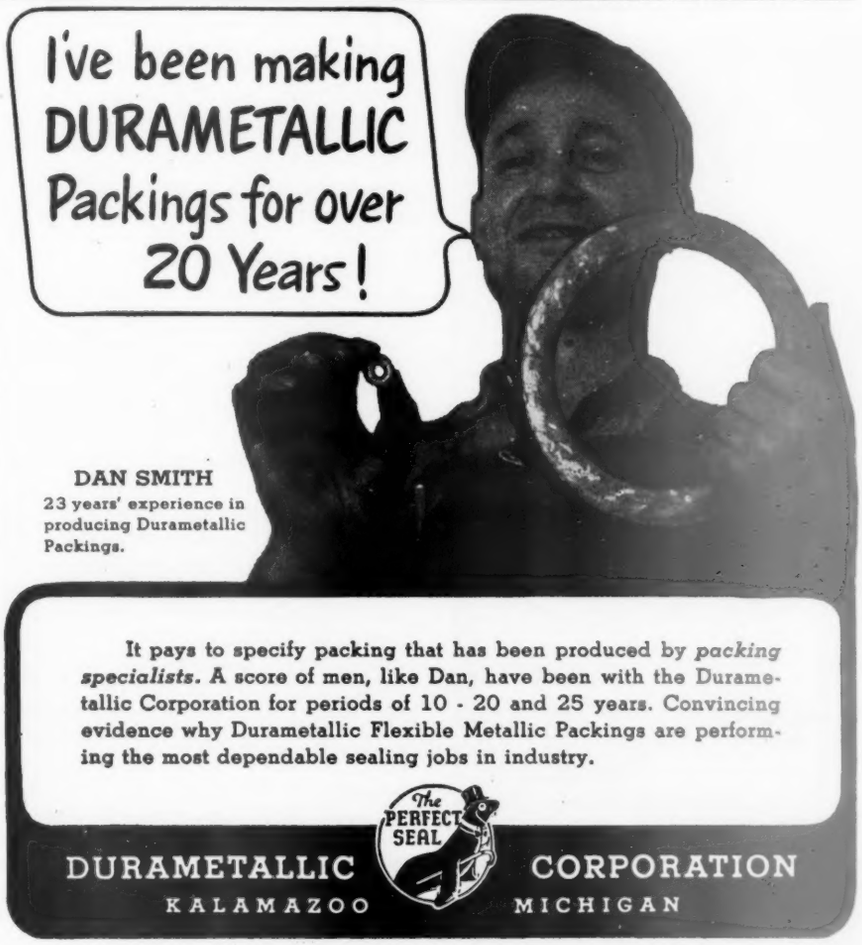
In other changes in the crude oil coordination department, **J. J. Pope** was made a division supervisor and **R. E. Watson** a group leader. Pope is a chemical engineering graduate from Illinois Institute of Technology, and Watson a petroleum engineer from Colorado School of Mines.

John P. McNaughton

John P. McNaughton has retired from the Petroleum Administration for Defense to join Neville G. Penrose, Inc., as assistant to the vice presidents. McNaughton received his degree in geology at the University of Oklahoma and in petroluem engineering at the Colorado School of Mines. Before going to Washington, McNaughton was for several years employed by the Gulf Oil Corporation at Hobbs in the West Texas and New Mexico Division.

B. H. Anderson of Continental Oil Company has been elected president of Petroleum Production Pioneers for 1953. Other new PPP officers for the year include: **E. A. Pellegrin,** Macco Corporation, vice president; **G. S. Follansbee, Jr.,** Universal Consolidated Oil, treasurer; **Don S. Grubbs,** Oil Well Supply, sergeant-at-arms, and **Paul Andrews,** Signal Oil and Gas, historian. **M. O. Johnston,** retired executive of Johnston Testers, Inc., was elected honorary president, and **A. A. MacDonald,** partner in MacDonald and Burns, was elected honorary vice president. Retiring president Rubel has been presented with a silver-mounted gavel by **L. L. Aubert** of Bankline Oil Company.

Wesley E. Downing has been appointed to membership on the National Petroleum Council. Downing, newly elected president of the Independent Oil Men's Association of New England, Inc., succeeds **Horace F. Davenport** of Salem, Massachusetts, outgoing president of the association.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DURAMETALLIC
Packings for over
20 Years!
DAN SMITH
23 years' experience in producing Durametallic Packings.
It pays to specify packing that has been produced by *packing specialists.* A score of men, like Dan, have been with the Durametallic Corporation for periods of 10 - 20 and 25 years. Convincing evidence why Durametallic Flexible Metallic Packings are performing the most dependable sealing jobs in industry.
The PERFECT SEAL
DURAMETALLIC CORPORATION
KALAMAZOO MICHIGAN

Visiting Houston Nomads recently were: Guy Woodruff, Mene Grande Oil Company, Barcelona, Venezuela; W. O. Calvert, manufacturing representative, London; H. W. Kendrick, Gulf Oil, Houston, Texas; S. M. Sims, Iraq Petroleum, Company, London, England; Oscar B. Irizarry, Petroleo Interamericano, Tulsa, Oklahoma, and E. J. Huber, Shell-Condor, Baranquilla, Colombia.

GREAT BEND
FISHING TOOL CO.
GREAT BEND, KANSAS
affiliated with

ACME
OIL TOOL COMPANY
• COMPETENT OPERATORS
• ROTARY FISHING TOOL SERVICE
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FOR MAXIMUM PERFORMANCE..
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▸ **Henry L. Waszkowski, Jr.,** assistant district production director, Magnolia Petroleum Company, has been named assistant director of the Production Division of the Petroleum Administration for Defense. **Howard S. Spering,** assistant to the vice president, Texaco Development Corporation, has been appointed assistant director (refining economics) of PAD's Refining Division. Deputy Petroleum Administrator J. Ed Warren announced. Waszkowski, who joined PAD last November as special assistant to the director of the production division, succeeds **Michael C. Brunner** of Midland, Texas. Brunner has worked for PAD since February 1952 and has been assistant director of the Production Division since last April. He leaves PAD to return to Shell Oil.

▸ **F. W. Kavanagh** has been appointed manager of petroleum products research, development and technical services divisions at the Richmond Laboratories of California Research Corporation. He succeeds **A. H. Batchelder,** who was recently elected a vice president of this Standard Oil Company of California subsidiary. Kavanagh, an engineering graduate of the University of California, joined Standard in 1930.

▸ **Henry F. Peters,** formerly project manager, Scientific Design Company, has been promoted to director of engineering in charge of project and production engineering for the engineering division of the company. Peters joined Scientific Design in 1948 and served as project manager until his present promotion.

▸ **Dudley Tower,** manager of operations for Union Oil Company of California in its Gulf division with headquarters in Houston, Texas, has been elected a vice president. Tower was educated at University of California at Los Angeles and University of California at Berkeley. He joined Union Oil in 1935. In 1943 he was promoted to district superintendent of the Gulf division and made manager of the division in 1947.

▸ **Julian M. Avery,** who has been a consultant to Ethyl Corporation for the past two years, has joined the Ethyl staff as a technical adviser, it is announced. He will work primarily with the planning group and will be in charge of technical contacts in foreign countries.

▸ **Eger V. Murphree,** president of the Permanent Council of the World Petroleum Congress, has returned to New York City from Rapallo, Italy, where he has been attending the recent meeting of the Council, January 20 to 22. Murphree stated that the purpose of the meeting had been to discuss the program and to outline the arrangements for the meeting of the Fourth World Petroleum Congress. This is to be held in 1955, from June 1 to 8, in Venice, Italy. Murphree is president of the Standard Oil Development Company, central research and engineering affiliate of the Standard Oil Company (New Jersey). He was recently named 1953 recipient of the Industrial Research Institute Medal.

Lewis H. Bond, Jr.

▸ **Lewis H. Bond, Jr.,** has been elected assistant vice president and petroleum engineer of the Fort Worth National Bank. Bond was graduated from the University of Oklahoma with a BS degree in petroleum engineering. Bond was employed by the Stanolind Oil and Gas Company as a petroleum engineer in 1946. In 1952, he became associated with The Fort Worth National Bank's oil loan division as a petroleum engineer.

▸ **K. B. Ford,** J. R. Butler and Company, has been named chairman of the Gulf Coast section of the American Institute of Mining and Metallurgical Engineers. Other officers include: **W. B. Hopkins,** Gulf Oil, vice chairman, and **Pete W. Cathon, Jr.,** City National Bank of Houston, secretary and treasurer. Directors are: **W. F. Herbert,** Texas Company; **H. M. Krause,** Humble Oil and Refining; **R. A. Bobo,** Phillips Petroleum, and **R. M. Darling,** Stanolind Oil and Gas, and **George R. Gray,** Baroid Sales Division.

▸ **B. I. Graves,** vice president and chairman of the operating committee of the Eastern division, Tide Water Associated Oil Company, is retiring from the service of the company, effective April 30, after more than 40 years of service. He is also resigning as a member of Tide Water Associated's board of directors. Graves began with the former Associated Oil Company as a clerk in the pipe line department at San Francisco. Since 1940, he has been in charge of all operations of the company's Eastern division, with headquarters in New York City. Graves plans to continue in the oil business after April 30 as a consultant, with offices in New York and California.

DEATHS

Paul W. Prutzman, retired oil company executive, died recently at his home in Los Angeles. One of the first chemists in the Pacific Coast oil industry, Prutzman began his professional career at the turn of the century. After working in an asphaltic refinery, he joined the California State Mining Bureau in 1906.

From 1928 until his retirement in 1945 he was Manager of Patents for General Petroleum.

J. F. Strayhorn, Service Pipe Line Company tax department official, died in Tulsa, Oklahoma, January 23. He was 45 years of age.

Thomas L. Taggart, manager of the Natural Gasoline Department of Standard Oil Company of California since 1942, died in San Francisco, January 22, following a week's illness. Taggart had worked for Standard since 1927. For 10 years he served as contract superintendent for Standard Gasoline Company, a subsidiary, and then in a similar position for the company's natural gasoline department until 1942.

Howard J. Nebeck of Universal Oil Products Company died of a heart attack at his home in Berwyn, Illinois, January 27, 1953. Nebeck, a graduate of the University of Illinois, joined Universal in 1937. As coordinator of engineering, he was well known in the petroleum industry for his work in the development and design of commercial alkylation units during the war and, more recently, his contribution to the development and design of commercial UOP Platforming units.

William H. Correa, former assistant to the president of Socony-Vacuum Oil Company, died in Cleveland, Ohio, February 15. A graduate of Stevens Institute of Technology in 1907, he joined Standard Oil of New York in 1908. He became general manager of Socony-Vacuum lubrication department in 1933, and assistant to the president in 1945. He had retired some time ago.

Donald B. Good, supervising engineer for Texas Pipe Line Company died February 6. His home was in Tulsa, Oklahoma.

Joseph O. Lugar, independent producer, died in Tulsa, Oklahoma, recently of a heart attack. He had retired from Deep Rock Oil about six years ago as assistant field superintendent.

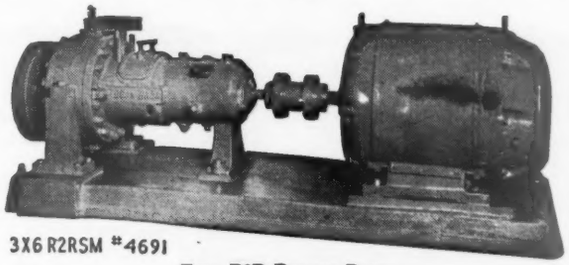
Edward Pace, Dallas, Texas, independent operator, and his wife were killed instantly in an automobile accident February 8 near Mount Vernon, Missouri.

J. C. Truman, retired pipe line construction contractor, died in El Dorado, Kansas, February 11. He had been with Ray L. Smith, for Truman and Smith.

Fred A. Wierum, materials department employee, Kerr-McGee Oil Industries, Inc., died January 30. Wierum joined Kerr-McGee in 1951 to serve as a materials supervisor for the Saudi Arabia-Kuwait Neutral Zone exploration project of American Independent Oil.

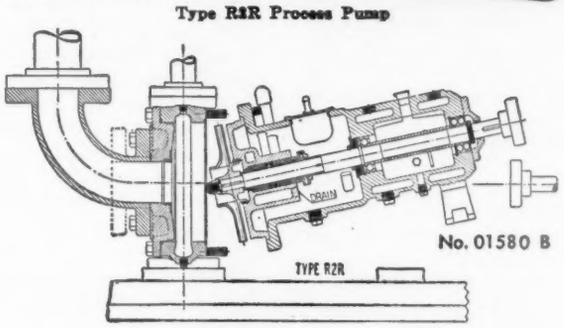
DEAN BROTHERS PUMPS INC.

Type R2R Centrifugal Process Pumps



3X6 R2RSM #4691

Type R2R Process Pump



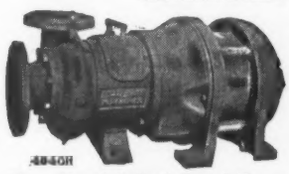
Type R2R Process Pump

DISASSEMBLY: The Type R2R process pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

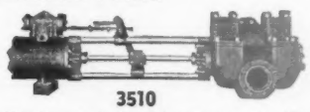
OPERATING RANGE: Type R2R, Heavy duty, process pumps are available in eighteen different sizes, enabling our engineers to furnish units specially designed and constructed for the particular work to be performed.
Capacities: 50 to 2000 Gallons per minute.
Heads: Up to 400'. Speeds: 900 RPM to 4000 RPM.

BUILDERS OF OUTSTANDING PUMPS SINCE 1869

CENTRIFUGAL AND RECIPROCATING PUMPS

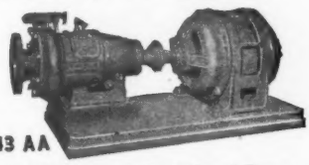


Close Coupled Centrifugal Pump



3510

Horizontal, Single Style, Double Acting, Piston Type, Close Clearance Pump. Designed to handle volatile liquids

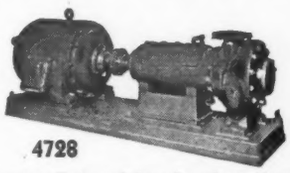


4043 AA

Pedestal Mounted Centrifugal Pump

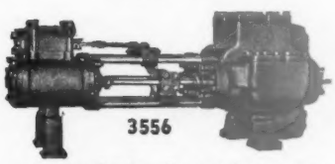
3833

Horizontal, Duplex, Double Acting, Side Pot, Piston Type, Oil Bath Power Pump



4728

Double Pedestal Bearing Centrifugal Pump



3556

Durable Duplex Packed Piston Pattern Steam Pump, Side Pot Type

ESTABLISHED 1869

DEAN BROTHERS PUMPS INC.

INDIANAPOLIS IND.

323 W TENTH ST.

Branch Offices: NEW YORK, N. Y., HOUSTON, TEXAS

Representatives in Principal Cities

To obtain more information on products advertised see page E-43

LAUGH with BARNEY

Mother: Susan, why do you make such a fuss about going to the dentist?

Susan: Oh, mother, I just can't stand being bored.

* * *

"You will very shortly meet a tall, dark man who will sweep you off your feet," the fortune teller told the eager blonde. "He will shower you with gifts and take you to breath-taking night spots, and you will drink a toast to everlasting love."

"Has he a lot of money?" asked the girl excitedly.

"He is president of a large firm and heir to a $900,000 estate."

"Gosh," exclaimed the girl. "Now just tell me one more thing."

"What is it, dear?" asked the soothsayer, visualizing many pieces of silver crossing her palm.

"What happens to my husband and the three kids?"

* * *

Johnny's report card was very unsatisfactory, and he was asked to explain.

"There's nothing to explain," he said. "You know how things are always marked down after the holidays."

* * *

He stared into a mirror one morning and, noticing his bloodshot eyes, resolved never to go into a bar again. Said he: "That television is ruining my eyes."

He sat down on the park bench and kissed the woman sitting next to him.

She: What's the idea?

He: Oh, pardon me, I thought you were my wife.

She: I am your wife, you dope!

* * *

He rounded a bend at close to sixty. A sudden skid and the car overturned. They found themselves sitting together unhurt beside the completely smashed car. He put his arm around her waist, but she drew away.

"It's all very nice," she sighed, "but wouldn't it have been easier to run out of gas."

* * *

Boss — to office boy who is half an hour late: You should have been here at nine o'clock.

Boy: Why, what happened?

* * *

Old Jed, who lived pretty far up the mountainside, got word through the grapevine that there was a special delivery letter awaiting him at the post office. As the village was located at the foot of the mountain, Jed started down to get his mail. About half way down, the steepness of the slope forced him into a trot. "Look at Jed," said one of his cronies lounging nearby. "Too lazy to hold back."

"It's oil, old man--LANE-WELLS, y'know"

Two well-known finishes for cars; Lacquer and liquor.

* * *

He: I heard a good one the other day — do you know the difference between caviar and hamburgers?

She: "No."

He: Good, waiter bring us two hamburgers.

* * *

A minister announced to his congregation that the 23rd Psalm would now be repeated in unison. Then he added, "Will the lady who always gets to the Still Waters while the rest of us are still in the Green Pastures, please wait until we catch up, and stay with the crowd?"

* * *

Young Actor: I've got a job at last, dad. It's a new play, and I play the part of a man who has been married for 20 years.

Father: Splendid! That's a start anyway, my boy. Maybe one of these days they'll give you a speaking part.

* * *

A talkative barber had recommended several remedies to the man in the chair, but all in vain. The customer maintained that he didn't need a massage, a manicure, or a shave—merely a haircut.

The barber, after a moment's silence, said, "Your hair's turning a little bit grav, sir."

"I'm not surprised," retorted the customer, "why don't you work a little faster?"

* * *

The way to tell a male sardine from a female is to watch and see which can they come out of.

* * *

Little Johnny was sad and dejected when he returned home after his first day at school.

"I ain't going tomorrow," he told his mother.

"Why not?" she asked.

"Well," he replied, "there's no use. I can't read and I can't write and they won't let me talk."

* * *

Teacher: "Did you write this poem yourself?"

Student: "Yes. Every line of it."

Teacher: "Glad to have you in my class, Edgar Allan Poe—I thought you were dead long ago."

* * *

Mike lay on his death bed. His inconsolable prospective widow stood over him. "Poor Mike," said she. "Is there anything that wud make you comfortable? Anything ye ask for I'll get for ye."

"Please, Bridget," he responded, "I think I'd like to have a wee taste of the ham I smell cookin' in the kitchen."

"Go on with ye," responded Bridget, "nary a bit of that ham will ye git. 'Tis for the wake."

* * *

And then there was the deaf-mute who fell in the well and broke three fingers screaming for help.

TON MILES

4-in. drill pipe — 15.7 lb. per foot

DEPTH	0	100	200	300	400	500	600	700	800	900
45,000 lb EXCESS WEIGHT										
0	0	1	3	5	7	8	10	12	14	16
1000	18	20	22	24	26	28	31	33	35	37
2000	39	42	44	46	49	51	54	56	59	61
3000	64	66	69	71	74	77	79	82	85	88
4000	91	93	96	98	102	105	108	111	114	117
5000	120	123	127	130	133	136	139	143	146	149
6000	153	156	160	163	167	170	174	178	181	184
7000	188	192	195	199	203	207	211	214	218	222
8000	226	230	234	238	242	246	250	254	259	263
9000	267	271	276	280	284	289	293	297	302	306
10000	310	315	320	324	329	334	338	343	348	352
11000	357	362	367	372	376	381	386	391	396	401
12000	406	412	417	422	427	432	437	443	448	453
13000	458	464	469	474	480	485	491	497	502	508
14000	513	519	525	530	536	542	547	553	559	565
15000	571	577	583	589	595	601	607	613	619	625
16000	631	637	644	650	656	662	669	675	682	688
17000	694	701	707	715	721	727	734	740	747	754
18000	760	767	774	781	788	794	801	808	815	822
19000	829	836	843	850	857	865	872	879	886	893
50,000 lb EXCESS WEIGHT										
0	0	1	3	5	7	9	11	14	16	18
1000	20	22	24	27	29	31	34	36	38	41
2000	43	46	48	51	53	56	59	61	64	67
3000	69	72	75	78	80	83	86	89	92	95
4000	98	101	104	107	110	114	117	120	123	126
5000	130	133	136	140	143	147	150	154	157	161
6000	164	168	171	175	179	182	186	190	194	198
7000	202	205	209	213	217	221	225	229	233	237
8000	241	245	250	254	258	262	267	271	275	280
9000	284	288	293	297	302	307	311	316	320	325
10000	330	334	339	344	349	354	358	363	368	373
11000	378	383	388	393	398	403	408	414	419	424
12000	429	434	440	445	450	456	461	467	472	478
13000	483	489	494	499	505	511	517	522	528	534
14000	540	546	551	557	563	569	575	581	587	593
15000	599	605	611	618	624	630	636	643	649	655
16000	662	668	674	681	687	694	700	707	713	720
17000	727	733	740	747	753	760	767	774	781	788
18000	795	801	808	815	822	830	837	844	851	858
19000	865	872	880	887	894	902	909	916	924	931
55,000 lb EXCESS WEIGHT										
0	0	2	4	6	8	10	13	15	17	19
1000	22	23	27	29	32	34	37	39	42	44
2000	47	50	52	55	58	61	63	66	69	72
3000	75	78	81	84	87	90	93	96	99	102
4000	106	109	112	115	119	122	125	129	132	136
5000	139	143	146	150	153	157	161	164	168	172
6000	176	179	183	187	191	195	199	203	207	211
7000	215	219	223	227	231	235	239	244	248	252
8000	257	261	265	270	274	278	283	288	292	296
9000	301	306	310	315	320	325	329	334	339	344
10000	349	353	358	363	368	373	378	383	389	394
11000	399	404	409	414	420	425	430	436	441	446
12000	452	457	463	468	474	479	485	491	496	502
13000	508	513	519	524	531	537	543	548	554	560
14000	566	572	578	584	591	597	603	609	615	621
15000	628	634	640	647	653	659	666	672	679	685
16000	692	698	705	712	718	725	732	738	745	752
17000	759	766	773	779	786	793	800	807	814	821
18000	829	836	843	850	857	865	872	879	886	894
19000	901	909	916	923	931	939	946	954	961	969

EXAMPLE: Ton miles per round trip at depth of 12,500 ft with 4-in., 15.7 lb drill pipe and 45,000 lb excess weight = 432.

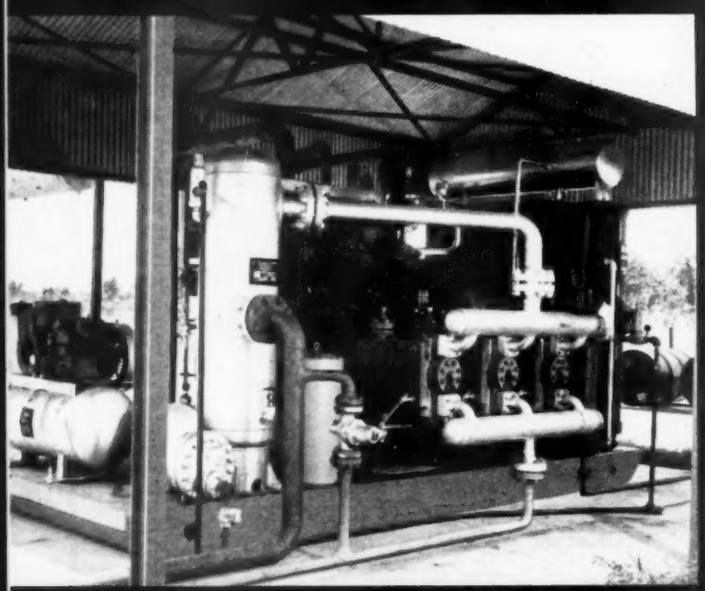
Courtesy Wickwire Rope, The Colorado Fuel and Iron Corporation

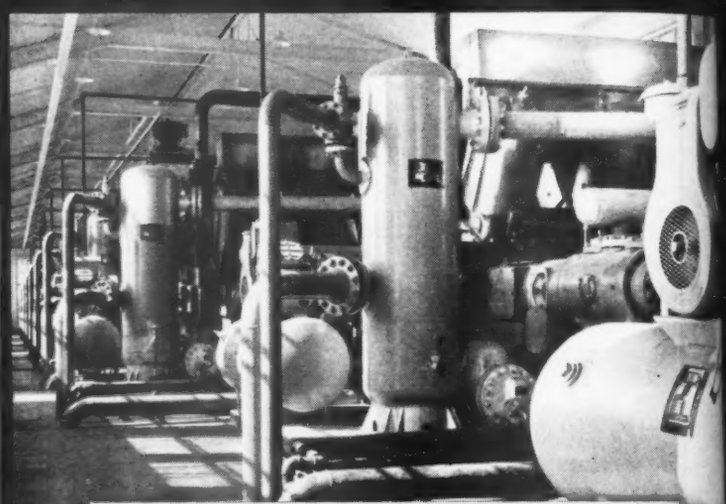
BEAIRD Ingersoll-Rand

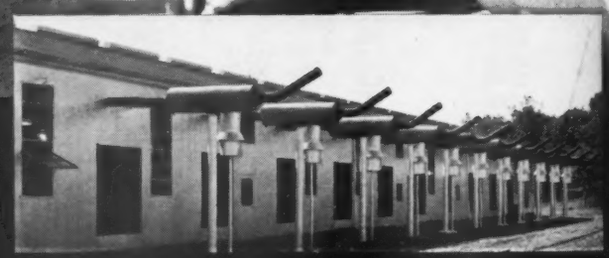
Packaged Compressor Plants

1 or 11

They Cost Less to Install —Cost Less to Operate







▲ A single 165 H.P. 6JVG packaged compressor plant used for gas boosting in the Carthage Field, Texas.

A bank of nine 440 H.P. and two 330 H.P. packaged compressor plants used for pipeline boosting in Pennsylvania. ▶

FOR USE IN:

Gas Lift
Field Gas Gathering
Flare Gas Collections
Repressuring

MACHINING
FABRICATING
STEEL WAREHOUSE

SINCE 1918
BEAIRD
SHREVEPORT

LOWEST COST PER HORSEPOWER, INSTALLED

Whether you need a single small compressor or a bank of large units, Beaird-Ingersoll-Rand packaged compressor plants *cut installation costs — cut operation costs.* For the same economies of packaging which have made single Beaird units lowest in cost per horsepower, also apply to large installations using many Beaird packaged plants. And multi-unit installations as well as single units have automatic controls which permit them to operate continuously without the expense of a regular attendant.

Let us show you how you can save on both installation and operation costs by using Beaird-Ingersoll-Rand packaged compressor plants.

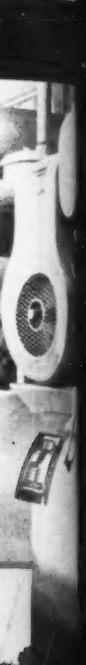
THE J. B. BEAIRD COMPANY, INC.
SHREVEPORT, LOUISIANA

CAST STEEL FITTINGS

ANHYDROUS AMMONIA EQUIPMENT

PRESSURE BULK STORAGE

LP-GAS SYSTEMS



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XUM

XUM

TON MILES

4-in. drill pipe — 15.7 lb. per foot

60,000 lb EXCESS WEIGHT

DEPTH	0	100	200	300	400	500	600	700	800	900
0	0	2	4	6	9	11	14	16	19	21
1000	25	26	29	32	34	37	40	42	45	48
2000	51	54	57	59	62	65	68	71	74	77
3000	81	84	87	90	93	97	100	103	107	110
4000	113	117	120	124	127	131	134	138	141	145
5000	149	152	156	160	164	167	171	175	179	183
6000	187	191	195	199	203	207	211	215	219	224
7000	228	232	236	241	245	249	254	258	263	267
8000	272	276	281	285	290	295	299	304	309	313
9000	318	323	328	333	338	343	347	352	358	362
10000	368	373	378	383	388	393	398	404	409	414
11000	420	425	430	436	441	447	452	458	463	469
12000	475	480	486	492	497	503	509	515	521	526
13000	532	538	544	549	556	562	568	574	581	587
14000	593	599	605	612	618	624	630	637	643	650
15000	656	663	669	676	682	689	695	702	709	716
16000	722	729	736	743	749	756	763	770	777	784
17000	791	798	805	812	819	827	834	841	848	855
18000	863	870	877	885	892	900	907	915	922	930
19000	937	945	952	960	968	975	983	991	999	1007

EXAMPLE: Ton miles per round trip at depth of 12,500 ft with 4-in., 15.7 lb. drill pipe and 60,000 lb excess weight = 503.

TON MILES

4½-in. drill pipe — 16.6 lb. per foot

15,000 lb EXCESS WEIGHT

0	0	1	1	2	2	3	4	5	6	7
1000	7	8	9	10	11	12	12	14	15	16
2000	17	18	20	21	22	23	25	26	27	29
3000	30	32	33	35	36	38	39	41	43	44
4000	46	48	49	51	53	55	57	59	61	63
5000	65	66	69	71	73	75	77	79	81	84
6000	86	88	91	93	95	98	100	103	105	108
7000	110	113	115	118	121	123	126	129	132	134
8000	137	140	143	146	149	152	155	158	161	164
9000	167	170	174	177	180	183	187	190	193	197
10000	200	203	207	210	214	217	221	225	228	232
11000	236	239	243	247	252	254	258	262	266	270
12000	274	278	282	286	290	294	299	303	307	311
13000	315	320	324	328	333	337	342	346	350	355
14000	359	364	369	373	378	383	387	392	397	402
15000	406	411	416	421	426	431	436	441	446	451
16000	456	461	466	472	477	482	487	493	498	503
17000	509	514	520	525	531	536	542	547	553	559
18000	564	570	576	582	587	593	599	605	611	617
19000	623	629	635	641	647	653	659	665	671	678

20,000 lb EXCESS WEIGHT

0	0	1	2	2	3	4	5	6	7	8
1000	9	10	11	12	14	15	16	17	18	20
2000	21	22	24	25	27	28	30	31	33	34
3000	36	37	39	41	43	44	46	48	50	52
4000	54	55	57	59	61	63	65	68	70	72
5000	74	76	78	81	83	85	88	90	92	95
6000	97	100	102	105	107	110	113	115	118	121
7000	123	126	129	132	135	138	141	143	146	149
8000	152	155	159	162	165	168	171	174	178	181
9000	184	188	191	194	198	201	205	208	212	215
10000	219	223	226	230	234	237	241	245	249	253
11000	256	260	264	268	272	276	280	284	289	293
12000	297	301	305	309	314	318	322	327	331	336
13000	340	344	349	354	358	363	367	372	377	381
14000	386	391	396	400	405	410	415	420	425	430
15000	435	440	445	450	455	458	466	471	476	481
16000	487	492	497	503	508	513	519	524	530	536
17000	541	547	552	558	564	569	575	581	587	593
18000	598	604	610	616	622	628	634	640	646	653
19000	659	665	671	677	684	690	696	703	709	715

EXAMPLE: Ton miles per round trip at depth of 12,500 ft with 4½-in., 16.6 lb drill pipe and 15,000 lb excess weight = 294.

Courtesy Wickwire Rope, The Colorado Fuel and Iron Corporation

XUM

what are the important factors in

FLOATING ROOF DESIGN?

Here are the Floating Roof Specifications which 30 years' experience has shown are necessary for best performance.

1. **Well designed, close fitting Seals; including Primary, Secondary, and Top Seals for maximum conservation.**
2. **Pontoons divided into large number of GAS-TIGHT compartments for safety.**
3. **Pontoon compartments Deep and Roomy so they may be easily entered and inspected for maintenance if necessary.**
4. **Pontoon compartments uncluttered with framework for easy inspection and maintenance.**
5. **COMPLETE CLEAN Drainage.**
6. **Roof designed to take ALL LOADS to which the structure may be subjected, with better than normal safety factor.**
7. **Pontoons designed to maintain buoyancy under all anticipated conditions.**
8. **Assure full use of the capacity of the tank for in and out storage.**

These specifications are met in every respect by the Wiggins Floating Roof and ONLY the Wiggins Floating Roof

by **GENERAL AMERICAN**

WIGGINS VAPOR SEALS GENERAL AMERICAN TRADE MARK

GENERAL AMERICAN TRANSPORTATION CORPORATION

135 SOUTH LA SALLE STREET • CHICAGO 90, ILLINOIS

TON MILES

4½-in. drill pipe — 16.6 lb. per foot

25,000 lb EXCESS WEIGHT

DEPTH	0	100	200	300	400	500	600	700	800	900
0	0	1	2	3	4	5	6	7	8	10
1000	11	12	13	15	16	18	19	20	22	23
2000	25	26	28	30	31	33	35	36	38	40
3000	42	43	45	47	49	51	53	55	57	59
4000	61	63	65	67	70	72	74	76	79	81
5000	83	86	88	91	93	96	98	101	103	106
6000	109	111	114	117	120	122	125	128	131	134
7000	137	140	143	146	149	152	155	158	161	164
8000	168	171	174	177	181	184	187	191	194	198
9000	201	205	208	212	216	219	223	227	230	234
10000	238	242	246	249	253	257	261	265	269	273
11000	277	281	286	290	294	298	302	307	311	315
12000	320	324	328	333	337	342	346	351	355	360
13000	365	369	374	379	383	388	393	398	403	408
14000	413	417	422	427	433	438	443	448	453	458
15000	463	468	474	479	484	490	495	500	506	511
16000	517	522	528	534	539	545	550	556	562	568
17000	573	579	585	591	597	603	609	615	620	627
18000	633	639	645	651	657	663	670	676	682	688
19000	695	701	707	714	720	727	733	740	746	753

30,000 lb EXCESS WEIGHT

0	0	1	2	4	5	6	7	9	10	11
1000	13	14	16	17	19	20	22	24	25	27
2000	29	30	32	34	36	38	39	41	43	45
3000	47	49	51	53	55	58	60	62	64	66
4000	69	71	73	76	78	80	83	85	88	90
5000	93	95	98	101	103	106	109	112	114	117
6000	120	123	126	129	132	135	138	141	144	147
7000	150	153	156	160	163	166	169	173	176	179
8000	183	186	190	193	197	200	204	207	211	215
9000	218	222	226	230	233	237	241	245	249	253
10000	257	261	265	269	273	277	281	285	290	294
11000	298	302	307	312	315	320	324	329	333	338
12000	342	347	351	356	361	365	360	375	380	384
13000	389	394	399	404	409	414	419	424	429	434
14000	439	444	449	455	460	465	470	476	481	486
15000	492	497	503	508	514	519	525	530	536	541
16000	547	553	559	564	570	576	582	588	594	600
17000	605	612	618	624	630	636	642	648	654	660
18000	667	673	679	686	692	698	705	711	718	724
19000	731	737	744	750	757	764	770	777	784	791

35,000 lb EXCESS WEIGHT

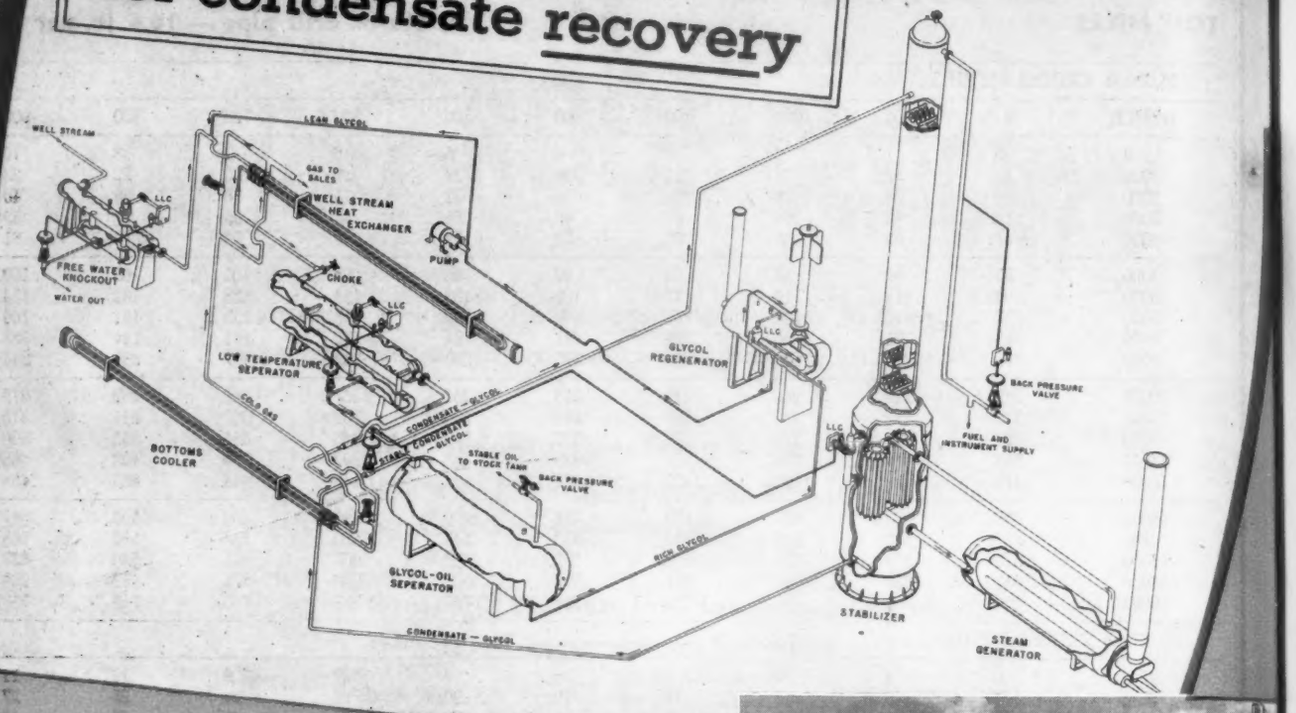
0	0	1	3	4	6	7	8	10	12	13
1000	15	16	18	20	21	23	25	27	29	31
2000	32	34	36	38	40	42	44	46	49	51
3000	53	55	57	60	62	64	67	69	71	74
4000	76	79	81	84	86	89	92	94	97	100
5000	102	105	108	111	114	117	119	122	125	128
6000	131	134	138	141	144	147	150	153	157	160
7000	163	167	170	173	177	180	184	187	191	194
8000	198	202	205	209	213	216	220	224	228	232
9000	235	239	243	247	251	255	259	263	267	272
10000	276	280	284	288	293	297	301	306	310	314
11000	319	323	328	332	337	342	346	351	356	360
12000	365	370	375	379	384	389	394	399	404	409
13000	414	419	424	429	434	439	445	450	455	460
14000	466	471	476	482	487	493	498	503	509	515
15000	520	526	531	537	543	549	554	560	566	572
16000	576	583	589	595	601	607	613	619	625	632
17000	638	644	650	656	663	669	675	682	688	694
18000	701	707	714	720	727	733	740	747	753	760
19000	767	773	780	787	794	801	808	815	821	828

EXAMPLE: Ton miles per round trip at depth of 12,500 ft with 4½-in., 16.6 lb drill pipe and 25,000 lb excess weight = 342.

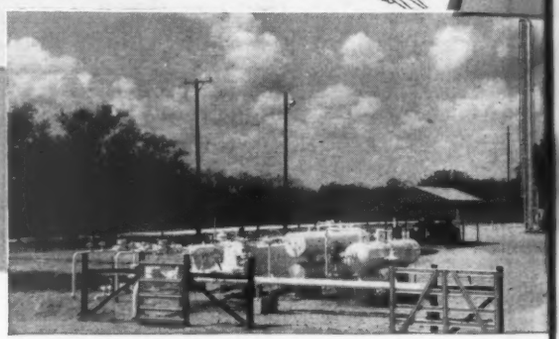
Courtesy Wickwire Rope, The Colorado Fuel and Iron Corporation

XUM

A complete plan for condensate recovery



Here's a typical flow chart that has already become a practical and profitable reality for a good many operators. The BS&B Glycol Injection System of Low Temperature Separation, with Stabilizer, has been installed and proven by both major and independent companies. The picture at right shows a typical installation. The results of actual field tests printed below show how a major oil company proved for themselves that the BS&B Glycol Injection System, with Stabilizer, can give 50% increased recovery over standard two stage separation. All equipment was tested under identical production conditions . . . from the same number of wells and the same wells.



BS&B Glycol Injection System OF LOW TEMPERATURE SEPARATION WITH STABILIZER*

Tested and Proven to Give 50% Increased Recovery

RESULTS SHEET	Standard Two-Stage	Conventional Low Temperature Mechanical Three-Stage	Glycol Injection Separation ††	Low Temperature With Stabilizer
FREE WATER KNOCKOUT				
Pressure, psig		3200	3180	3180
HIGH PRESSURE SEPARATOR				
Pressure, psig	870	930	1090	1080
Temperature, °F	85	+20†	+20	−13
SALES GAS				
MMSCF/D (14.7 psia & 60°)	547	548	5.42	547
STOCK TANK				
°API Gravity	45.7	53.0	54.4	55.5
PRODUCTION				
BBLS/MMSCF Sales Gas @ 60°F from stock tank	11.6	14.4	16.4	17.4
Percent Increase in Recovery over Standard 2-Stage Operation	0	24%	41%	50%

† This was Lowest Temperature that could be obtained.

†† This run was made with the Low Temperature separator at exactly the same temperature as with the Mechanical Low Temperature Unit, in order to show the effect of stabilization.

See Our Exhibit
OIL SHOW
TULSA MAY 14-23

* Patented and Patents Pending

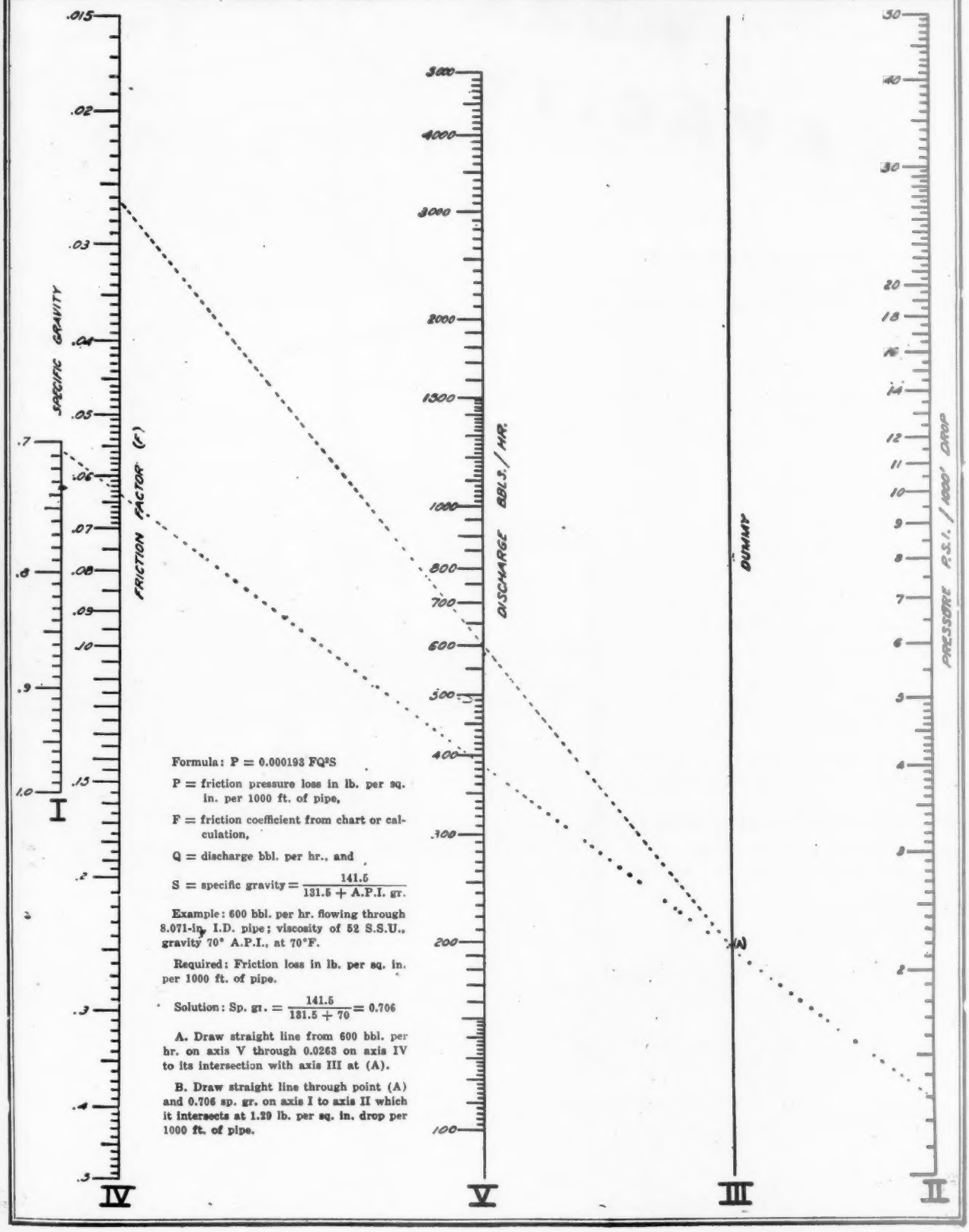
EFFICIENCY BS&B RELIABILITY

BLACK, SIVALLS & BRYSON, INC.

Oil & Gas Equipment Division, Dept. 1-C3

2131 Westwood Blvd. Oklahoma City, Oklahoma

SOLUTION OF FORMULA $P = 0.000193\ FQ^2S$ FOR OIL FLOW IN 8-IN. STD. PIPE



Formula: $P = 0.000193\ FQ^2S$

P = friction pressure loss in lb. per sq. in. per 1000 ft. of pipe,

F = friction coefficient from chart or calculation,

Q = discharge bbl. per hr., and

S = specific gravity = $\frac{141.5}{131.5 + \text{A.P.I. gr.}}$

Example: 600 bbl. per hr. flowing through 8.071-in. I.D. pipe; viscosity of 52 S.S.U., gravity 70° A.P.I., at 70°F.

Required: Friction loss in lb. per sq. in. per 1000 ft. of pipe.

Solution: Sp. gr. = $\frac{141.5}{131.5 + 70} = 0.706$

A. Draw straight line from 600 bbl. per hr. on axis V through 0.0263 on axis IV to its intersection with axis III at (A).

B. Draw straight line through point (A) and 0.706 sp. gr. on axis I to axis II which it intersects at 1.29 lb. per sq. in. drop per 1000 ft. of pipe.

Extra WORK CAPACITY

WITH KOEHRING

25-TON 304 CRANE

Reserve strength and operating stability of Koehring 304 Crane gives 13.9-ton lift and boom lengths up to 75 feet on crawler mounting . . . 25-ton lift capacity and maximum reach up to 110 feet (including jib) on rubber-tired truck or cruiser mounting.

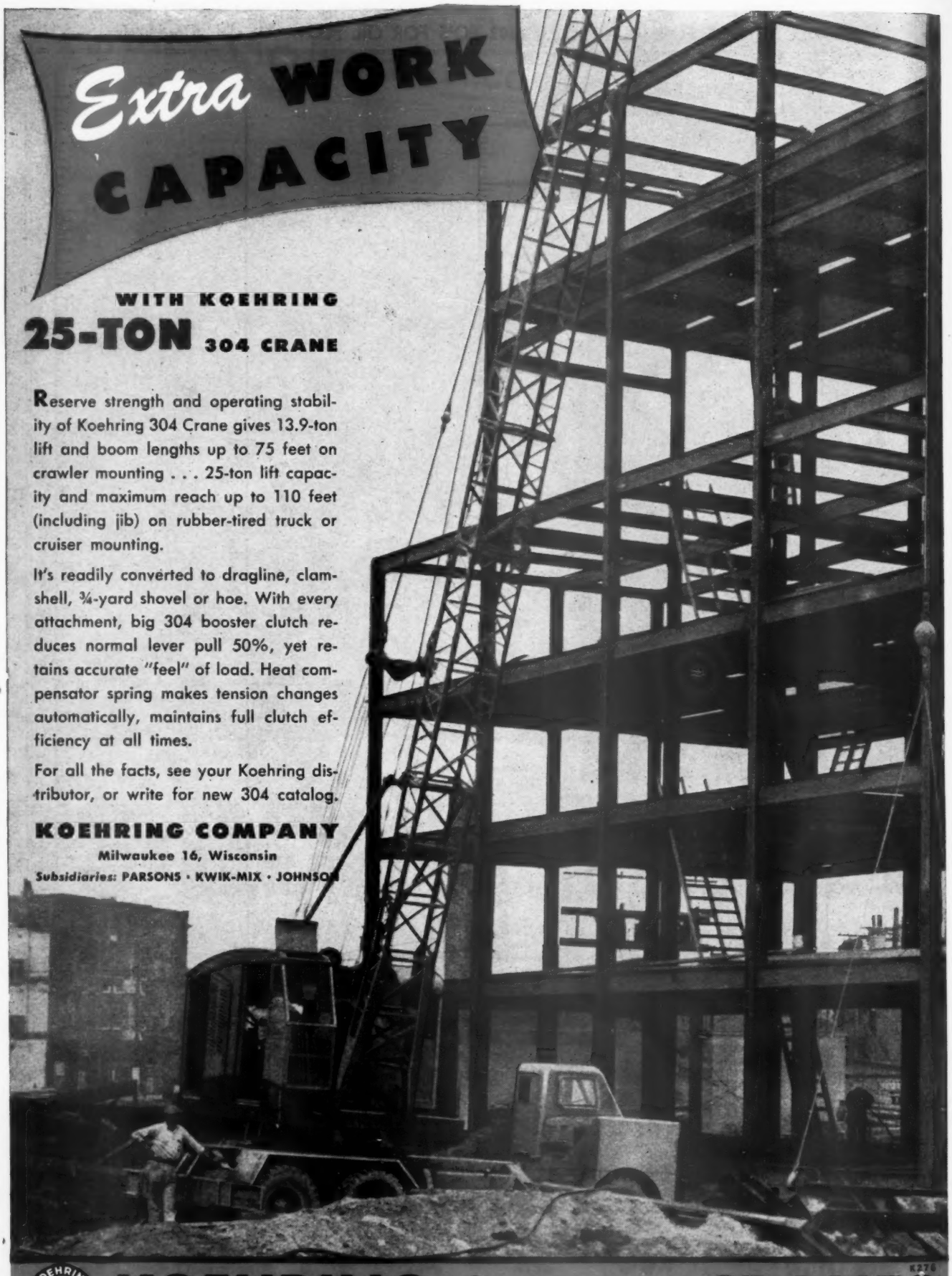
It's readily converted to dragline, clamshell, ¾-yard shovel or hoe. With every attachment, big 304 booster clutch reduces normal lever pull 50%, yet retains accurate "feel" of load. Heat compensator spring makes tension changes automatically, maintains full clutch efficiency at all times.

For all the facts, see your Koehring distributor, or write for new 304 catalog.

KOEHRING COMPANY

Milwaukee 16, Wisconsin

Subsidiaries: PARSONS · KWIK-MIX · JOHNSON



KOEHRING HEAVY DUTY

KOEHRING *heavy-duty* CRANES

K270

7¾ to 79½ TONS lift capacities . . . EXCAVATORS ½ to 2½ yards

CHART FOR DETERMINING THE VALUE OF "F" FOR USE IN THE FORMULA $P = 0.000193\ FQ^2S$ FOR OIL FLOW IN 8-IN. PIPE

Formula:

$$X = 22.12\frac{Q/D}{\mu/S}$$

Where:
X = criterion,
Q = discharge, bbl. per hr.,
D = inside diameter of pipe, in.,
μ = abs. viscosity in poises, and
S = sp. gr.
$= \frac{141.5}{131.5 + °A.P.I.}$

Example:

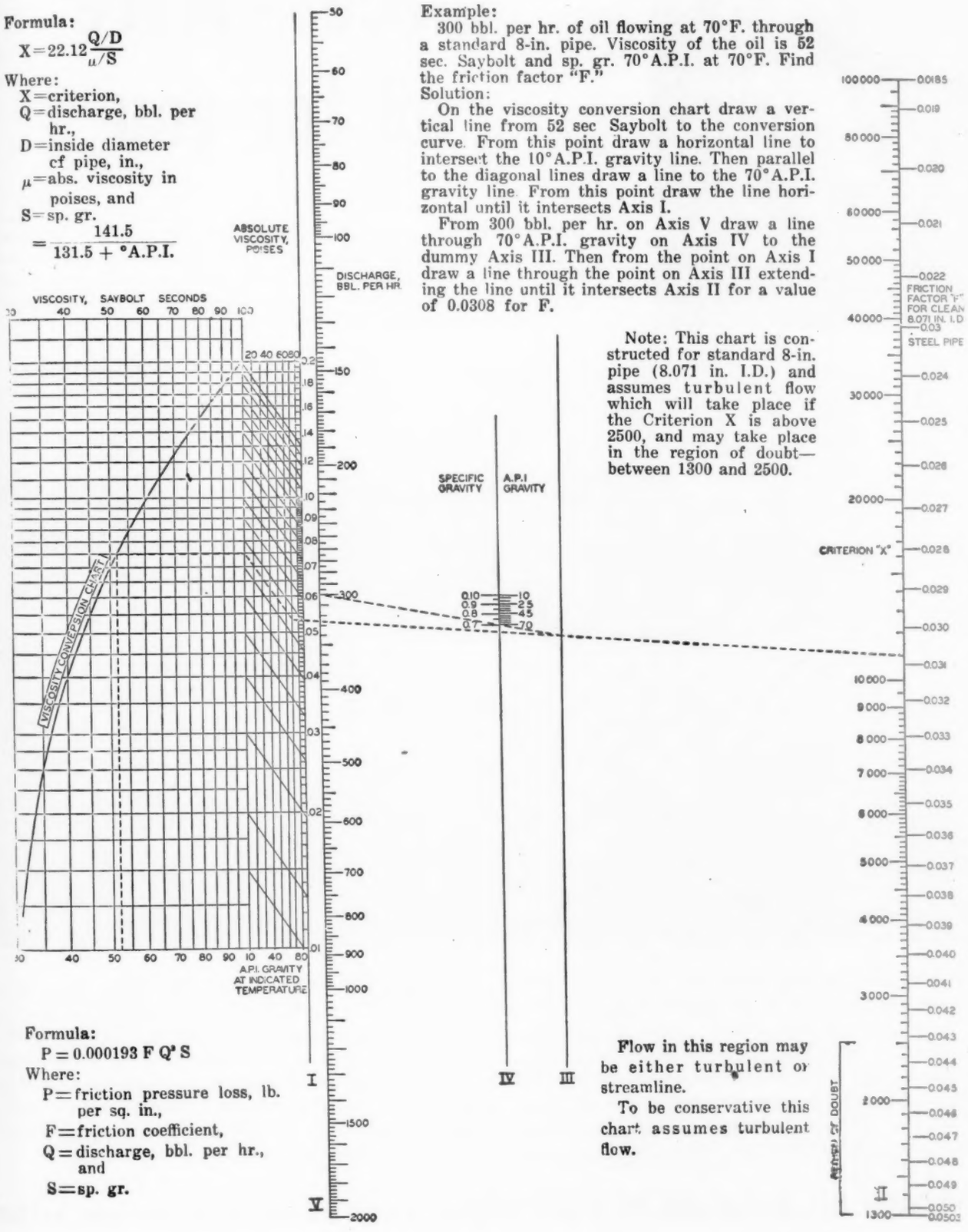
300 bbl. per hr. of oil flowing at 70°F. through a standard 8-in. pipe. Viscosity of the oil is 52 sec. Saybolt and sp. gr. 70°A.P.I. at 70°F. Find the friction factor "F."

Solution:

On the viscosity conversion chart draw a vertical line from 52 sec Saybolt to the conversion curve. From this point draw a horizontal line to intersect the 10°A.P.I. gravity line. Then parallel to the diagonal lines draw a line to the 70°A.P.I. gravity line. From this point draw the line horizontal until it intersects Axis I.

From 300 bbl. per hr. on Axis V draw a line through 70°A.P.I. gravity on Axis IV to the dummy Axis III. Then from the point on Axis I draw a line through the point on Axis III extending the line until it intersects Axis II for a value of 0.0308 for F.

Note: This chart is constructed for standard 8-in. pipe (8.071 in. I.D.) and assumes turbulent flow which will take place if the Criterion X is above 2500, and may take place in the region of doubt—between 1300 and 2500.



Formula:

$P = 0.000193\ F\ Q^2\ S$

Where:
P = friction pressure loss, lb. per sq. in.,
F = friction coefficient,
Q = discharge, bbl. per hr., and
S = sp. gr.

Flow in this region may be either turbulent or streamline.

To be conservative this chart assumes turbulent flow.

From faraway places—more oil for you

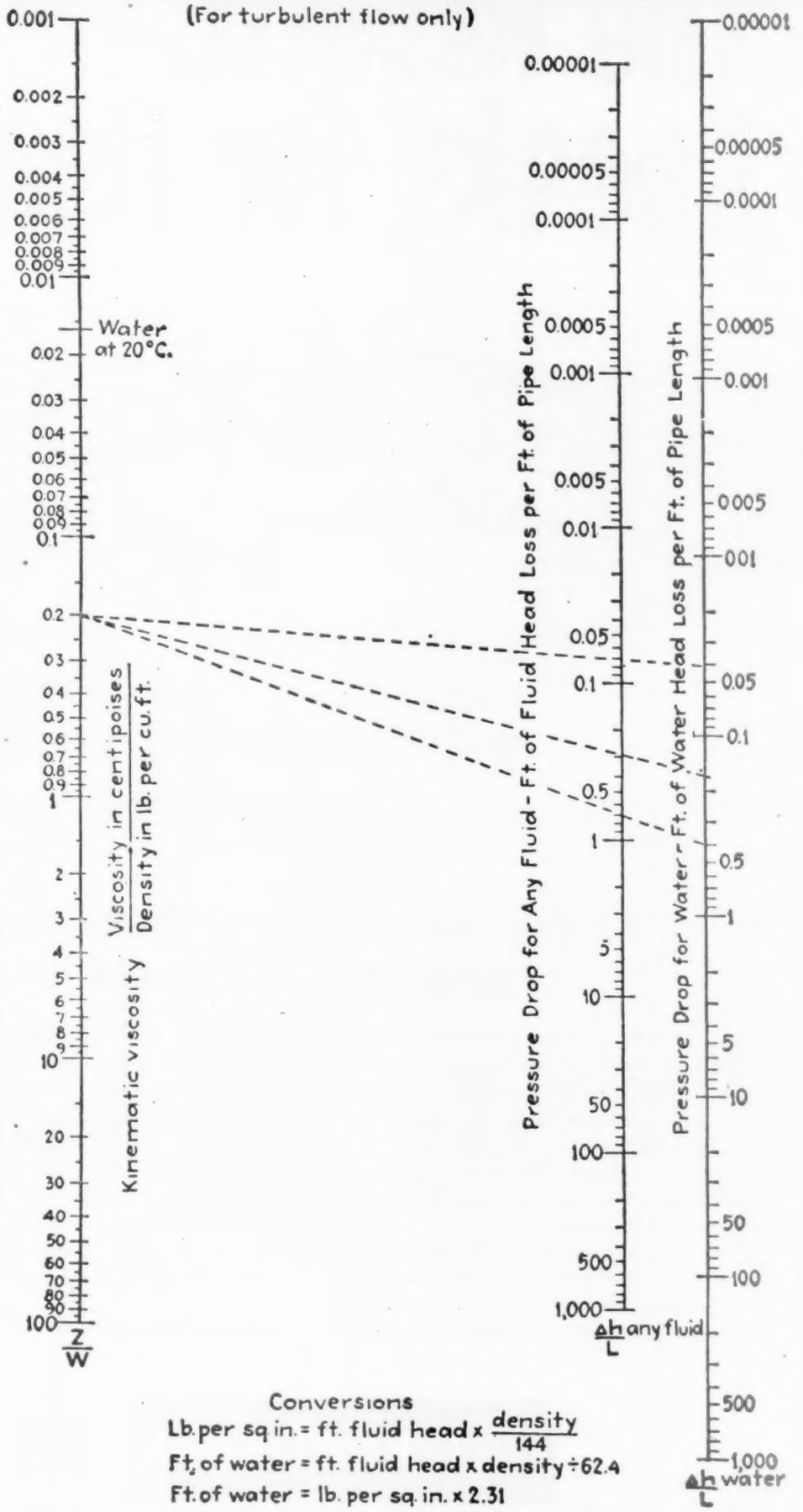
In Sumatra back in 1924, Standard Oil Company of California geologists began mapping possible deposits of oil. But not until last year did Sumatran wells start adding to available oil supplies. This operation, costing some $62 million to date, was pioneered by Standard. It is now carried on jointly with The Texas Company under the name "Caltex."

Into San Francisco Bay come tankers carrying Sumatran crude—returns on the gamble Standard undertook nearly 30 years ago. Other shipments go elsewhere in the world, aiding progress and adding defensive strength. Four friendly nations in particular benefit directly. First, of course, is the young Indonesian Republic, of which Sumatra is a part. Then Australia, Japan and the Philippines. They produce practically no oil of their own, but will be supplied in the near future by refineries which Caltex is helping to build. ¶ And, of course, the Sumatran oil brought into this country helps keep you in gasoline and the many other petroleum products you've come to rely on. ¶ The foreign activities of Standard Oil Company of California, typified by this flow of crude from faraway Sumatra, are constantly being expanded, as an added guarantee that petroleum needs of the free world will continue to be met.

STANDARD OIL COMPANY OF CALIFORNIA ***plans ahead to serve you better***

PRESSURE-LOSS CONVERSION CHART FOR PUMPING FLUIDS

(For turbulent flow only)


Water at 20°C.
Viscosity in centipoises / Density in lb. per cu. ft.
Kinematic viscosity
Z/W
Pressure Drop for Any Fluid - Ft. of Fluid Head Loss per Ft. of Pipe Length
Δh any fluid / L
Pressure Drop for Water - Ft. of Water Head Loss per Ft. of Pipe Length
Δh water / L

Among the most convenient ways of calculating the friction loss in a pipe for a liquid other than water is to determine the friction loss with water and then convert to the loss with the liquid actually flowing in the pipe. Numerous handbooks and tables give the friction loss for water in various types and sizes of pipe and various rates of flow.

In converting friction loss with water to the friction loss of the liquid being piped, the absolute viscosity of the liquid at the average flowing temperature must be known and its specific weight. The kinematic viscosity may then be found and the friction loss converted from that of water under the same conditions.

Reproduced by permission of *Chemical and Metallurgical Engineering*, January, 1943, from article by W. E. Pratt, Worthington Pump and Machinery Corporation.

Conversions

Lb. per sq. in. = ft. fluid head $\times \frac{\text{density}}{144}$

Ft. of water = ft. fluid head $\times$ density $\div 62.4$

Ft. of water = lb. per sq. in. $\times 2.31$

"The Record Speaks for Itself"

Fast cleanup. W. H. Harder's International TD-14A crawler is a real producer on this lease near Borger, Texas, where the tractor is shown winding up cleanup work around a well in a jiffy.

Texas oil field contractor finds record workpower, durability in his TD-14A

Up until 1948 W. H. Harder, oil field contractor from Borger, Texas, was a mighty hard fellow to please when it came to crawler tractors. It seemed to him he was always paying too many repair bills and getting too little work out of his crawlers in return. But 1948 was the year he bought his first International TD-14A and things are different now.

"*The record made by my Internationals in the last four years speaks for itself,*" says Harder. "*We worked other tractors of equal size alongside our first TD-14A and our International outclassed the field. As for upkeep, that TD-14A worked for more than 10,000 hours. Rails and rollers were replaced at 7,000 hours and that old engine never did need anything but one set of rings and valves.*"

If you are plagued with crawler problems, see your International Industrial Distributor. He can give you a sure-fire prescription for profits: International—Power that Pays.

INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILL.

INTERNATIONAL — INTERNATIONAL HARVESTER — POWER THAT PAYS

PHYSICAL CONSTANTS OF PARAFFIN HYDROCARBONS

	Methane	Ethane	Propane	Isobutane	N-butane	Isopentane	N-pentane	N-hexane	N-heptane	N-octane	N-nonane	N-decane
Molecular formula	CH_4	C_2H_6	C_3H_8	C_4H_{10}	C_4H_{10}	C_5H_{12}	C_5H_{12}	C_6H_{14}	C_7H_{16}	C_8H_{18}	C_9H_{20}	$C_{10}H_{22}$
Molecular Weight	16.042	30.068	44.094	58.120	58.120	72.146	72.146	86.172	100.198	114.224	128.250	142.276
Melting point at 14.696 lb. per sq. in. abs.												
°C	−182.5	−183.2	−187.7	−159.4	−138.3	−160.6	−129.7	− 95.4	− 90.6	− 56.8	− 53.7	− 29.7
	28	38	37	55	55	29	55	29	29	7	7	2
°F	−296.5	−297.8	−305.9	−255.3	−216.9	−257.1	−201.5	−139.7	−131.1	− 70.0	− 64.7	− 21.5
Boiling point at 14.696 lb. per sq. in. abs.												
°C	−161.4	− 89.0	− 42.1	− 11.7	− 0.5	+ 27.9	36.1	68.7	98.4	125.7	150.7	174.0
	24	38	6, 37	55	16	55	6, 15	15, 6	15, 17, 36			
°F	−258.5	−128.2	− 43.8	+ 10.9	+31.1	+ 82.2	97.0	155.7	209.1	258.1	303.3	345.2
Density of liquid												
Specific gravity at 60/60°F	0.3**	0.374	0.508	0.563	0.584	0.625	0.631	0.664	0.688	0.707	0.722	0.734
	19, 20, 21	44	41	41	23, 5, 41	12	14, 15, 41	5, 13, 34	14, 15	52	24	1
°A.P.I.	340**	247	147.0	119.8	110.8	94.6	92.7	81.6	74.2	68.6	64.5	61.3
Lb. per gal. at 60°F	2.5**	3.11	4.23	4.69	4.86	5.20	5.25	5.53	5.73	5.89	6.01	6.11
Gal. per lb mol at 60°F	6.4**	9.64	10.41	12.38	11.94	13.84	13.71	15.57	17.47	19.38	21.31	23.25
Density of vapor												
60°F 14.696 lb. per sq. in.abs ***												
Specific gravity (air=1.00)	0.554	1.038	1.522	2.006	2.006	2.491	2.491	2.975	3.459	3.943	4.428	4.912
Lb. per M. cu. ft.	42.27	79.23	116.2	153.1	153.1	190.1	190.1	227.1	264.0	301.0	337.9	374.9
Cu. ft. vapor per gal. liquid	59**	39.35	36.45	30.65	31.79	27.41	27.67	24.38	21.72	19.58	17.81	16.32
Ratio, gas vol. per liquid vol ***	443**	294.3	272.7	229.3	237.8	205.0	207.0	182.4	162.5	146.5	133.2	122.1
Critical conditions												
Temperature °C	− 82.5	+ 32.3	96.8	134.0	152.0	187.8	197.1	234.8	267.0	296.0	322.1	346.1
	24	39, 36	30	24	39	24	24	24	17	24	33	33
Temperature °F	−116.5	+ 90.1	206.2	273.2	305.6	370.0	387.0	454.6	512.6	564.8	612.0	655.0
Pressure atmospheres	45.8	48.2	42.0	36.1	37.5	32.8	33.0	29.5	27.0	24.6	22.9	21.2
	24	39	30	2	39	24	24	24	17	24	33	33
Pressure lb. per sq. in. abs.	673	708	617	530	551	482	485	434	397	361	337	312
Density lb. per gal.	1.351	1.695	1.888	1.946	1.891	1.955	1.935	1.958	1.957	1.942	1.935	1.919
	25	39	25	25	39	25	25	25	25	53	54	54
Volume, cu. ft. per lb. mol.	1.586	2.371	3.123	3.990	4.130	4.930	4.98	5.88	6.84	7.86	8.86	9.91
Gross heat of combustion												
B.t.u. per lb. vapor*	23,920	22,350	21,690	21,290	21,340	21,060	21,120	20,970	20,860	20,780	20.710	20,660
	3	3	3	5	3	40	5	3	3		3	3
B.t.u. per cu. ft. *	1,011	1,771	2,521	3,259	3,267	4,003	4,015	4,762	5,507	6,255	6,998	7,745
B.t.u. per gal. liquid at 60°F.		68,900	91,300	99,300	103,000	108,700	110,000	114,900	118,500	121,300	123,500	125,300
					56		56	56	56	56	56	56
Explosion limits—Lower per cent in air	4.9-6.2	3.0-3.3	2.0-2.4	1.80	1.5-1.9	1.32	0.3-2.5	1.1-1.3	1.0-1.1	0.95	0.83	0.67
	31	31	31	31	31	45	31	31	31	45	45	45
—Upper per cent in air	12.7-16.0	10.6-15.0	7.0-9.5	8.44	5.7-8.5	....	4.5-7.5	4.2-6.0	3.6-6.0	....	....	....
Cu. ft. air to burn 1 cu. ft. gas	9.55	16.71	23.87	31.03	31.03	38.19	38.19	45.35	52.06	59.67	66.83	73.99
Heat of vaporiz. 14.696 lb. per sq. in. abs.												
B.t.u. per lb. at B.P.	245	211	183	158	166	146	153	146	138	131	125	120
	50	50	50	50	50	50	50	50	50	50	50	50
Specific heat												
14.696 lb. per sq. in. abs.												
Cp vapor B.t.u. per lb. °F	0.526	0.413	0.390	0.406	0.396	0.413	0.402	0.406	0.415	0.420	0.429	0.436
	4, 47, 48	4, 47, 48	4, 47, 48	4, 47, 48	4, 47, 48	4, 47, 48	4, 47, 48	4, 47, 48	4, 47, 48	4, 47, 48	4, 47, 48	4, 47, 48
Cv vapor B.t.u. per lb. °F	0.402	0.347	0.346	0.373	0.365	0.387	0.376	0.384	0.397	0.404	0.415	0.424
N = Cp/Cv B.t.u. per lb. °F	1.306	1.189	1.128	1.088	1.090	1.066	1.070	1.057	1.045	1.040	1.034	1.028
Cp liquid B.t.u. per lb. °F	....	....	....		0.55 at 32		0.55	0.536	0.522	0.519	0.518	0.517
					24		27	53	6		48	48
Vapor pressure												
At 100°F lb. per sq. in. abs.	....	....	189.6	73.5	52.0	20.3	15.6	5.0	1.63	0.54	0.19	0.06
			46, 10	26, 24	22, 18	24	11, 18	24, 18	24, 18	42	42	42
Aniline point °F				225.7	181.2	174.0	159.3	155.5	159.1	161.1	166.1	171.5
				46	46	46	51	46	46	46	46	46
Refractive index N_D^{20C}						1.3540	1.3577	1.3750	1.3878	1.3976	1.4056	1.4120
						51	51	51	51	51	51	48

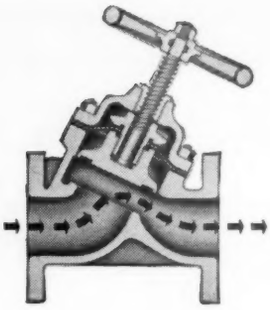
NOTES: 1. Sub-numerals shown with values refer to references in the bibliography shown on P 771.B. Where none are given, the values were calculated from those with references.

2. The values in the table were adopted in 1945 as standard values by the California Natural Gasoline Association and the Natural Gasoline Association of America.

*Gross heat on dry basis at 14.696 lbs./sq. in. Abs. and 60° F. To convert to water saturation basis, multiply by 0.9825.

**Apparent values for dissolved Methane @ 60° F.

***Based on "perfect gas." —*Table by courtesy of the Natural Gasoline Association of America.*



FOR SAFER CONTROL →→→→

PHYSICAL CONSTANTS OF HYDROCARBONS

Hydrocarbon	Specific gravity 20/4 °C.	M. P. °C.	B. P. °C.	Index of refraction n_D^{20}	Viscosity Abs. Poises	Spec. heat	Heat of vaporization Cal/G.	Heat of combustion K-Cal/mol.	Aniline point °C.	Coeff of expansion °C.	Critical constants P Atms.	Critical constants T °C.	Critical constants D	Vapor pressure °C.	Vapor pressure mm.	Octane number Actual	Octane number Blending	Surface tension 20°C. Flash °C.
C_2H_4 Ethylene (ethene)	0.9852 (air)	−169.4	767.5	−100 1.363	0.000093°(g)	$^{26.8}$0.371(g)	118.5	337.28p		$^{-17.8}$0.006894	50.9	9.8	0.22	−125.2	174.0	>100r	85.5r	−103.9
	0.5699 (−103.9)		−103.9		0.000099 $^{17.1}$									−110.0	523.4	81.0m		16.50
C_3H_6 Propylene (propene)	1.49 (air)	−185.2	−47.6	−40 1.3567	0.000078°(g)	$^{26.17}$0.371(g)	108.8	491.82p		$^{-17.2+10}$0.002718	45.4	91.4	0.233	−85.02	75.7	>100r	102r	−47.0
	0.5148				0.0000840									−60.60	404.6	85m		16.70
C_4H_8 1-Butene	1.93 (air)	−190	− 6.32	−25 1.3777	0.000070°(g)	$^{20-140}$0.366(g)	93.8	649.66p		$^{20-30}$0.002052	42.1	160.0		−28.07	300			−6.1
	0.5952				0.0000819 ^{40}									− 16.69	500	80m	111.5r	15.9
														− 1.92	900			
2-Butene*	2.004 (air)	−127.0	1.0		0.000069°(g)	$^{20-140}$0.366(g)	96.3	638.2		$^{20-30}$0.002037	42.1	155.0		−19.2	334.7			1.0
	0.6300 1.0				0.0000796 ^{40}									− 4.7	609.8	83m		16.7
2-Methyl-propene (isobutene)	2.011 (air)	−140.7	− 6.93	1.3796 −25	0.000073°(g)	$^{20-140}$0.366(g)	93.8	647.2p	14.9	$^{20-30}$0.001954	39.48	144.7	0.234	−28.52	300			−6.6
	0.5942				0.0000843 ^{40}									−17.19	500	87m		15.72
														− 2.50	900			
C_5H_{10} 1-Pentene (amylene)	2.42 (air)	−138.0	30.1	1.3710	0.0022 ^{20}	0.282°	$^{12.5}$75.0	806.78p	19.0		40.4	201.2				92r	98.5r	
	0.6410																	
2-Pentene*	2.42 (air)	−138.0	36.4	1.3797		0.515 ^{16}		794.5	18.3		40.4	202.4				98r	125r	16.93
	0.6505															80m	107m	
2-Methyl-2-Butene (Trimethyl-ethylene	2.42 (air)	−133.6	38.49	1.3869	0.00252 ^{c}	0.508 ^{16}	93.1	795.7p	12.8	$^{15-20}$0.00158	35.3	191.6		2.5	184.7	98r	157r	17.34
	0.6620				0.0023 ^{10}									18.1	359.1		122m	
C_6H_{12} 1-Hexene	2.902 (air)	−141.0	63.7	1.3880	0.002885 $^{-20}$	0.499 $^{22.4}$	82.54	963.9p	22.8			243.5		10	90	80r	85r	17.77
	0.67337													60	600			
2-Hexene*	0.6813	−149.0	67.9	1.3928	0.00314 ^{20}		84.33	962.3p	26.0			243.8		0	50	89r	100r	18.93
			68.1											60	600	78m		
3-Hexene	0.6816 ^{19}		66.6	1.3942	0.00335 ^{20}		84.87	950.8	27.0 $^{est.}$							97r	19.48	
			67.0															
2-Methyl-1-Pentene	0.6817		61.5–62.0	1.3921				950.8									69.5m	

See table P 771.001. B for footnotes.

Table from "Physical Constants of the Principal Hydrocarbons," by M. P. Doss, 4th edition, by courtesy of copyright owner, The Texas Company.

OIL and GAS TRADE NEWS

Lane-Wells Organizes Geophysical Department

Lane-Wells has created a geophysical section to provide better service for its 8000 oil company customers, according to Rodney S. Durkee, president.

John Stick, Jr., formerly chief electrical engineer and associated with Lane-Wells since 1937, has been appointed chief geophysical engineer in charge of the new section.

A. B. (Burm) Winter, formerly assistant chief electrical engineer, has been appointed chief electrical engineer. He has had a varied experience with Lane-Wells since going to work as a gun perforating operator in California in 1934.

Kansas Store Opened

Mid-Continent Supply Company president, Ken W. Davis, has announced erection and opening of a new store in Liberal, Kansas. Manager of the Liberal store is B. G. Remmert, formerly at Great Bend and Plainville. R. F. Timmons and C. L. Washburn are field salesmen and J. R. Miller, J. L. Wood, and J. L. McHenry are storemen. The location is under the supervision of Great Bend district manager B. S. Harkrider.

Sales Office Established

Lane-Wells Company has established a division sales office at 809 Continental Life Building in Fort Worth, Texas. H. A. Metzger will represent the company as division sales engineer.

Foxboro Announces New Kansas Branch

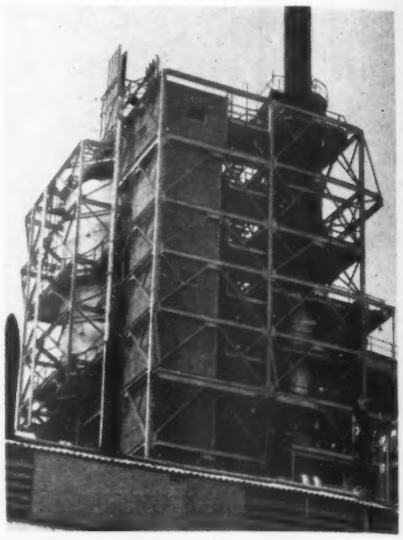
The Foxboro Company has opened a new branch office at Wichita to serve instrument users in the Kansas area. It is situated at 2207 South Pinecrest. Appointed resident engineer at the Wichita office is Dale G. Hugley, who moves to his new assignment after several years of service with the Tulsa branch as industrial engineer.

Monitoradio Moves Office To Chicago, Illinois

Monitoradio, a line of receivers and transmitters for mobile or stationary communications systems, has transferred its sales offices to Chicago, Illinois. New address is 1604 West 92nd Street. Until now, all sales have been handled through factory offices of the Radio Apparatus Corporation, Indianapolis manufacturers of this equipment.

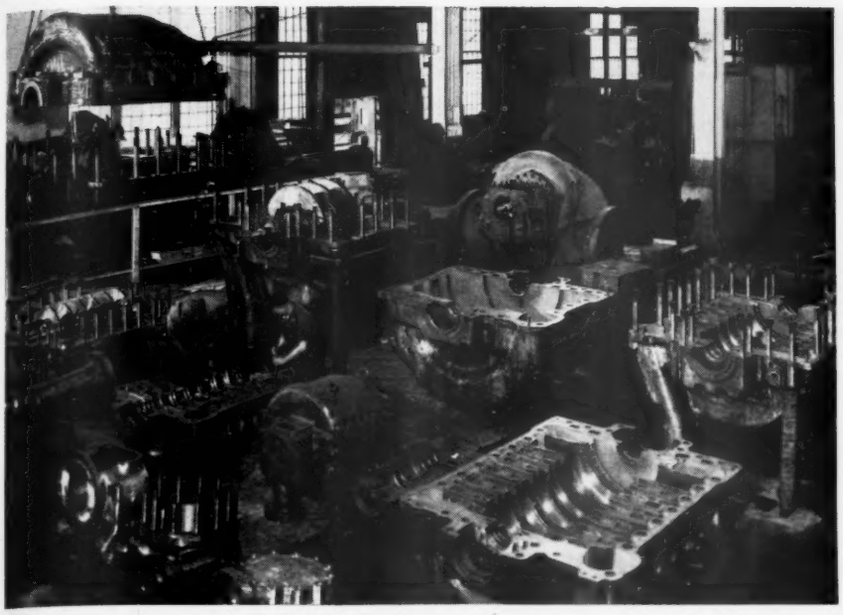
Oxygen Plant Scheduled

Air Reduction Sales Company will soon begin construction of a new liquid oxygen plant in Riverton, New Jersey, 10 miles northeast of Camden, it was announced by H. R. Salisbury, president. The new plant, which is scheduled to begin production next year, will primarily serve the Delaware River Basin industrial area. Deliveries of liquid oxygen, supplementing the production of other Air Reduction plants, may be made north to New England and south to the Carolinas.



Burgess-Manning Company's Dallas division was established in 1951. It is directed by R. L. Leadbetter, vice president, and S. G. Paddock, manager of sales. Typical engineering and product service is represented by a recent installation for Union Oil Company of California at its Universay Oil Products, catalytic-cracking unit at Wilmington, California. Shown above is special 66-in. flue-gas snubber method in tower of UOP cat-cracker in Wilmington. The Dallas division is directed specifically to requirements of the petroleum and chemical industries.

Sales representatives of the Continental Supply Company with officials of The Lunkenheimer Company during distributor sales conference in Cincinnati, Ohio. Front row: M. W. Pauly, R. O. Hambric, J. I. McQuiddy, R. Hortenstine, Jr., H. C. Beeson, W. T. Hays, B. L. Hindman, Van C. Moore, W. E. Young, D. A. Davis, R. L. Pebworth, T. H. Pyle and H. H. Layritz. Back row: H. J. McMann, R. T. Klein, D. P. Davis, A. A. Dunaway, W. G. Sharp, J. R. Osteen, T. H. Fraser, N. D. Lane, W. R. Gottshall, E. R. Tieberman, and D. L. Smith. Principal emphasis of conference was placed on Lunkenheimer's new non-slip handwheel.



Upper left shows a final machining operation for Clark Brothers No. 6 unit as the two case halves are assembled in preparation for the return-bend milling operation. Balance of picture shows final Clark assembly floor where nine different sizes and types of Clark centrifugals are in various stages of assembly.

Shreveport Headquarters for New Engineering Firm

A new engineering firm has established headquarters in Shreveport, Louisiana. To be known as the Stracho Engineering Corporation, the firm also will specialize in machinery and product development. A. M. Croswell will serve as executive vice president, and Walter S. Rae Jr., will be vice president and chief engineer. Offices of the firm are located in the First National Bank Building. For the past two years, Croswell has been welding and project engineer for Gulf Southern Contractors. Rae, since 1950, has been design engineer for the design development department of the A. O. Smith Corporation.

Dallas PGAC Office Opens

Paul Charrin, president of Perforating Guns Atlas Corporation, announces the opening of the company's 22nd office, in suite 1317 of the new Fidelity Union Building, at Dallas, Texas. The company's new Dallas sales office will be under the direction of Lee Bone, Jr., district sales manager. Bone was previously in charge of field operations at PGAC's office at Longview, Texas, where he served for three years.

L. Bone, Jr.

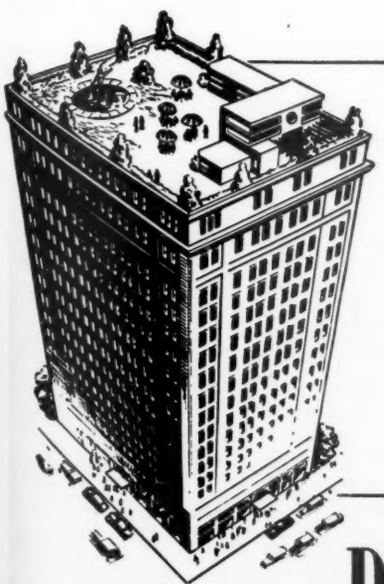
Filter Paper Agents Named

The National Filter Media Corporation, New Haven, Connecticut, has been appointed exclusive world-wide distributors of "Netone-5," a Neoprene impregnated filter paper, manufactured by Claremont Paper Mill, Claremont, New Hampshire.

Oliver Opens L. A. Offices

Oliver United Filters Inc., announces an arrangement for local sales and engineering representation in Southern California, Arizona, Nevada, and New Mexico. R. M. Stampley, long with the Oakland office, has been assigned to this important territory.

Detroit's Leading Commercial Hotel



Stay at the newest, most centrally located hotel in the Motor City, completely fireproof, 750 outside rooms with bath, smart new furnishings, lowest comparable rates, ample parking space — a find for the cost-conscious traveler! *Dining Rooms Air Conditioned*

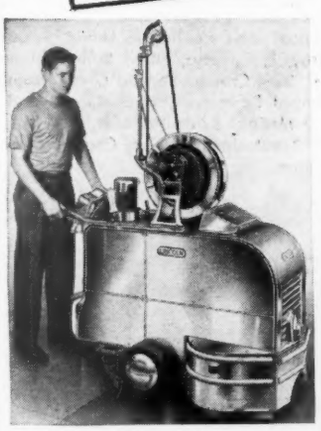
The NEW Hotel Detroiter

Woodward at Adelaide, Detroit 1, Michigan

Convention and Touring Groups Invited

EXPLOSION-PROOF!!

These Special LINCOLN Machines will Scrub, Wax and Polish Your Laboratory Floors to Shining Cleanliness with Absolute Safety!!



$AVE UP TO 75% ON FLOOR SCRUBBING!

Let us prove, without cost or obligation, that even in highly combustible atmospheric locations ONE MAN and a LINCOLN Floor Machine can save you up to 75% on your floor maintenance costs.

There is a recommended LINCOLN for every floor cleaning operation. Ask for a FREE Demonstration

The LINCOLN Model 216EP Explosion-Proof Scrubber and Polisher

Above: the Lincoln Model 500 E AUTO SCRUBBER that scrubs, rinses and dries up to 400 sq. ft. per minute. Electrically operated, explosion-proof construction.

Write Dept. 2-53 for details.

Lincoln-Schlueter FLOOR MACHINERY COMPANY

1244 WEST VAN BUREN ST., CHICAGO 7, ILLINOIS

MORE THAN 55 YEARS OF SERVICE

World's Manufacturer of the Most Complete Line of Floor Maintenance Equipment

G. J. Bell, vice president for production; C. L. Coughlin, president; R. W. Griffith, vice president for manufacturing of Briggs and Stratton examine the company's 1,000,000th industrial engine produced in 1952.

Edward Valves' new engineering building at East Chicago, Indiana. New building; situated next to Edwards' lab, was built and designed for Edwards engineering department.

Plastic Sales Up

While practically all sections of the plastics industry experienced market and production expansion in 1952, one group—the Reinforced Plastics Division—enjoyed a production increase of approximately 40 per cent according to The Society of the Plastics Industry, Inc. Approximately 19,000,000 lb of polyester resins for reinforced plastics products were sold in 1952. This compares with approximately 14,000,000 lb in 1951; about 9,000,000 lb in 1950, and about 7,000,000 lb in 1949.

Kellogg Sets Up Warehouse In West Coast Area

M. W. Kellogg Company, a subsidiary of Pullman Inc. has established new warehousing facilities for its product Kel-F on the West Coast, it was announced by Louis C. Rubin, manager of Kellogg's chemical manufacturing division. The facilities will be in Vernon, California, for delivery of Kel-F molding powders in that state as well as in Oregon, Washington, Arizona, Nevada, and Utah.

Alten Opens Warehouses

Warren M. Benson, vice president and sales manager, Alten Foundry and Machine Works, Inc., announces that his company has, during the last 90 days, opened three new warehouses increasing the number of Alten field stocking branches to five, with each carrying pumping equipment stock.

New branches are in Casper, Wyoming, Dean L. Richardson, manager; Houston, Texas, Henry H. Paris in charge, and Edmonton, Alberta, Canada. Jerrold A. Drexel, manager.

Engineering Firm Opens New Jersey Plant

Engineering Corporation of America has acquired additional plant fabricating facilities at 257 North Avenue, Garwood, New Jersey. Fitch B. Jefferies, president of the corporation, announces that the firm will continue to sub-contract work to local firms.

G & G Company Will Handle Carter Pumping Units

S. C. Carter Co., Inc., Los Angeles, announce the appointment of G & G Machine and Equipment Company as distributor for the state of Oklahoma. G & G, operated by Dick Gordon and Jack Gant, maintain complete machine shop facilities, and will handle sales and service from Healdton and Tulsa.

Lufkin Foundry and Machine holds annual sales meeting in Lufkin, Texas. Attending were, first row: G. L. Vickrey, F. C. Hays, Elbert Butler, Glenn Henderson, W. W. Trout, L. A. Little, Guy Croom, Vernon Glenn, Louis Fincher; second row: T. A. Banta, Harold Bowerman, Elvin Read, W. T. Crowder, Jr., Ben Sargent, Jr., Oliver McKay, Byron Robbins, Billy Burnett; third row: Bob Spaulding, E. P. Trout, Jack Gissler, Charles Dyer, Hubert Dyer, J. D. Bradley, J. T. Hood, Bob Miller, Cooper Richards; fourth row: G. W. Nichols, R. C. Thompson, Louis Breeden, Dan Martin, John Swanson, Ed Terrill, Val Gallia, C. M. Wooten; fifth row: H. H. Muller, D. A. Reid, Ernest Slaughter, John Metteauer, T. L. Bowers, T. D. Lashley, Fred Griffin, Bob Poland, Jack Reid, Bill Miner. Lufkin representatives cover all the oil fields in U. S., Canada, and South America.

TRADE PERSONALS

Frank Kelso has been named West Texas service engineer with headquarters at Odessa. Kelso received his schooling at UCLA and has been with Western Inspection Company. In his new duties he will be working with his father Carroll Kelso.

T. E. Ward, Jr., has been elected executive vice president of Oilfield Equipment Company, Inc. Ward was graduated from Yale University and attended the Colorado School of Mines. Besides his academic training he has had practical experience in the oil fields in Venezuela.

Leonard P. Mellgren has been appointed district sales engineer and will head the company's new district offices in Minneapolis, Minnesota, for De Laval Steam Turbine Company of Trenton, New Jersey.

Wilfred Gains and Allan Hokanson have been named engineers on the staff of Vulcan Copper and Supply Company. Gains as project engineer will be engaged in the design and construction of high pressure synthetic plants. Hokanson, development engineer, was formerly associated with the research and development department of Colgate-Palmolive-Peet Company.

J. E. Fitzgerald has been appointed purchasing agent for the Texas district of Consolidated Western Steel. Fitzgerald will have his headquarters at Consolidated Western's plant at Orange, Texas.

O. J. Fister has been named director of employee relations for the Oil Well Supply Division of United States Steel. Fister joined "Oilwell" in 1948. In 1951 he was transferred to Dallas.

Arthur J. Penick

Arthur J. Penick, one of the founders of Oil Center Tool Company, was in Houston recently. He has spent the last seven years in various hospitals in New York state. Penick was formerly chairman of the board of O-C-T.

James E. Webb, former secretary of state for three years, will head Republic Supply Company, subsidiary of Kerr-McGee Oil Industries, Inc., when the company moves to Oklahoma City, April 1. The company will move from Houston, Texas. Webb is a director of Kerr-McGee.

L. R. Lyon

M. A. Ellsworth

M. A. Ellsworth, formerly vice president of the Mid-Continent area for The Fluor Corporation, Ltd., has been appointed vice president and director of sales for Fluor. He has been associated with Fluor for the last 11 years.

L. R. Lyon, formerly district engineer for Fluor's Tulsa district sales office has been apointed as district sales manager of the Tulsa office.

Thomas A. Collins, executive vice president of Glass Fibers Inc., has been appointed general manager of the company. In his new capacity Collins will coordinate production, sales, advertising, and public relations activities.

Robert A. Phillips has been appointed chief design engineer of Lane-Wells Company. A graduate of California Institute of Technology, he has been with Lane-Wells 12 years and until recently has been assistant to the chief engineer.

Claude Houck, associated with Lane-Wells since 1940, has been appointed assistant to the chief engineer. He is a graduate of Iowa State College.

S. K. Hostetter

G. F. Turechek

W. T. Doherty

E. F. Conroy

E. K. Knight

R. L. Bowcutt

J. Kemper

Samuel K. Hostetter, Jr., has been named sales manager of the Crocker-Wheeler division of Elliott Company. Hostetter, a graduate of Pennsylvania State College, joined Elliott Company in 1934. For the past 10 years, he served as manager of the Washington office, where he supervised Elliott sales.

George F. Turechek, Lane-Wells executive, has been appointed to the newly created post of consulting engineer. He has been one of the prolific inventors in the company and his inventive talents will be fully utilized in this new position, as he will be entirely freed from administrative duties. Turechek is the third oldest Lane-Wells employee in point of seniority.

W. T. Doherty of Houston has been elected to the board of directors of the First National Bank in Houston. Doherty is president of the Mound Company, vice president of the Fidelity Oil and Royalty Company, and a member of various oil associations.

Eugene F. Conroy has been appointed district manager of the New York office of the Spang-Chalfant Division, National Supply Company. He succeeds W. W. Stanton, who retired December 31, 1952, after 20 years service. Conroy has been associated with the steel pipe industry for 40 years. He was promoted to assistant district manager, his former position, in 1946.

Earl K. Knight has been named field representative in the Odessa, Texas area, for Technical Oil Tool Corporation. Knight will be stationed at Odessa, and will work under the direction of Hugh I. Weathersby, Totco West Texas division manager.

R. L. "Don" Bowcutt has recently been named by Baash-Ross Tool Company as district sales manager for Rocky Mountain and Western Canadian operations. Bowcutt has been with the Baash-Ross organization for a number of years, most of them in the Rocky Mountain area. Headquarters will be in Casper.

Jackson Kemper has been elected vice president, H. K. Porter Company, Inc. Kemper will continue in his present capacity as general manager, Watson-Stillman fittings division of the Porter Company at Roselle, New Jersey. All operating and sales activities of this division are under his supervision.

Henry P. Wickham, long associated with M. W. Kellogg's fluid catalytic processing developments, has been selected to manage the company's expanded operating division. Wickham's duties with Kellogg will be "largely concerned with the company's desire to broaden its long-standing technical service efforts," it was announced. **Joseph W. Smith** has been appointed general manager of construction of Kellogg Company.

H. P. Wickham

Trade Personals

J. F. Alexander

E. L. Bissett

H. W. Wallace

E. J. Calk

James F. Alexander, formerly Los Angeles district superintendent for Lane-Wells, has returned to the company after a 16-month tour of duty with the Army. He is now assistant to the Mid-Continent division operating superintendent. Alexander had been with Lane-Wells for over three years when he was recalled and given a military leave of absence to report for active duty.

E. L. Bissett was recently placed in charge of the large McEvoy Company warehouse at the Alice Specialty Company in Alice. Bissett joined McEvoy in 1952.

Harry W. Wallace has been elected president of Wheel Trueing Tool Company's Canadian subsidiary, Wheel Trueing Tool Company of Canada, Ltd. He was vice president and general manager of the Canadian plant and vice president in charge of the Diamond Drilling Division of American and Canadian plants.

Earle J. Calk, general sales manager, LeBus International Engineers, Ltd., has returned from a two months' engineering and sales training trip to Trinidad, Venezuela, Colombia, and Mexico. During Calk's trip to South and Central America, Petroleum Service and Supply C. A. of Maracaibo and Caracas, Venezuela, were formally set up as the complete sales, service, engineering, and warehouse outlet for the LeBus Grooving and Wire Line Spooling System in all of South America. Petroleum Service and Supply is establishing warehouse and service facilities in Anaco, Venezuela, as well as Peru and Colombia.

Another engineering, service, and warehouse outlet also is being established in Mexico City by LeBus. On May 1, Calk leaves for Europe and the Middle East to establish sales, service, engineering, and warehouse outlets for LeBus Grooving.

James W. Murhpy has been named manager of sales, stainless and alloy castings division, Allegheny Ludlum Steel Corporation. Murphy has been with the company since 1936, and has served as assistant sales manager of the castings division recently.

Thomas S. Walsh will become the new factory representative of The Rust-Oleum Corporation for its complete line of rust-preventive products in Metropolitan New York and the Northern New Jersey trade area.

E. M. Fetzer, formerly manager of the production equipment division of Continental Supply Company, Dallas, has been appointed to the position of manager of production equipment sales for

E. M. Fetzer

O. C. Tubbs

their subsidiary, Continental Supply Company, Ltd., in Canada. Headquarters for the Canadian company are in Calgary, with J. H. Berry as managing director. Fetzer has been with The Continental Supply Company since graduation from the Oklahoma A & M College in 1929. Succeeding Fetzer as manager of the production equipment division is **Odus C. Tubbs,** formerly of the Houston district office. He is former manager of production equipment sales for the Gulf Coast in Houston.

T. A. LaBrecque has been elected a vice president of the Hilliard Corporation and will continue as manager of the purifier division in charge of sales and engineering. He has been associated with Hilliard since 1926.

T. A. LeBrecque

D. Clinton Grove has been named to the staff of Reuter and Bragdon, Inc. He has been associated with Blaw-Knox Company for many years and served as advertising manager and later as assistant to the executive vice president and consultant to the advertising and public relations department.

Carter H. Gray has been appointed assistant superintendent of the continuous weld pipe mill at Kaiser Steel's Fontana works. Also announced was a change of responsibility for **Charles S. McClure** of Ontario. Formerly general foreman of the continuous weld finishing department. McClure was appointed general foreman of the finishing and galvanizing department of the continuous weld pipe mill.

William A. Hebert, president of the Springfield Fire and Marine Insurance Company, was elected president of the American Foreign Insurance Association, New York, to succeed **D. R. Ackerman,** chairman of the board of the Great American Insurance Company, who had served two years. **F. A. Christensen,** president of the America Fore Group of Companies and **John A. North,** president of the Phoenix Insurance Company of Hartford, Connecticut, were elected vice presidents.

George J. Fischer has been elected vice president, sales, and **Matthew J. Betley** vice president, manufacturing, of Aeroquip Corporation. Fischer was former general sales manager. Prior to joining Aeroquip, he was 18 years with the B. F. Goodrich Company. Betley assumes his new post after serving Aeroquip as works manager. He was previously associated with Electric Sprayit Corporation.

Arthur Langton, well-known advertising man, editor, and writer, has become associated as an account executive and technical writer with Darwin H. Clark Company. Langton is well-known throughout the oil, chemical, and mining industries, having been editor of the Baroid News and advertising manager of the Baroid Sales Division of National Lead Company, a concern with which he was associated for 16 years.

Van H. Leichliter has been named vice president of operations of American Steel and Wire, a United States Steel division.

Leichliter, who has been assistant vice president of operations since February 1, 1950, succeeds Walter F. Munford, who assumed the presidency of the Wire Division. Leichliter was first employed by American Steel and Wire in 1930.

John A. Slenker has been named assistant vice president of operations of American Steel and Wire Division, United States Steel. Slenker, who comes to his new position in Cleveland, Ohio, from Duluth, Minnesota, where he was district manager of operations for the wire division, succeeds Leichliter.

C. W. Kalchthaler has been appointed assistant to the general sales manager, Hyatt Bearings Division, General Motors Corporation, with headquarters at Harrison, New Jersey. Kalchthaler has been assistant manager of Hyatt sales office in Detroit, Michigan.

Albert P. Woody has been appointed a consultant in steam generation, combustion and boiler process heating for Eggelhof Engineers in Houston. Woody formerly operated his own company, A. P. Woody Engineering Company for six years. Previously he was chief engineer of the F. J. Evans Engineering Company for 10 years.

A. P. Woody

L. A. Allaud and **H. A. Nystrom,** have been named technical assistants to the

H. A. Nystrom

C. Edgecomb

L. A. Allaud

vice president, operations and general services; **R. K. Thies,** assistant to the vice president, personnel relations, and **Clark Edgecomb,** assistant to the sales manager, of Schlumberger Well Surveying Corporation.

Allaud is a native of France and joined SPE in March, 1935. He came to the United States the following year and went to work for Schlumberger. Nystrom joined Schlumberger in 1937 and served in Louisiana and Texas before being assigned to Mt. Vernon as district manager. Thies joined Schlumberger in 1939. He was district engineer in Tyler until his present appointment. Edgecomb joined Schlumberger in 1943. He has been district engineer at Ventura since 1948.

Robert F. Carr, Jr., has been named vice president of Dearborn Chemical Company. Carr will make his headquarters in Chicago after February 1st, and will work with the present heads of the company's sales departments to promote the general over-all sales of all Dearborn products. He joined Dearborn in 1934.

Colonel Willard R. Rockwell, Pittsburgh industrialist and chairman of the board of Rockwell Manufacturing Company, Standard Steel Spring Company, Timken-Detroit Axle Company, has been named a key aide in reorganization of the Mutual Security Program. In a recent meeting in New York with President Eisenhower and Governor Stassen, Colonel Rockwell was advised that he had been drafted for service with the Mutual Security Agency.

Tracy T. Word, Jr., has been named manager of sales for Thornhill-Craver Company. Word is widely known in oil circles. He began his career in the oilfield equipment manufacturing and supply business in 1934.

T. T. Word, Jr.

O. B. Wilson has been named industrial instruments sales manager for the industrial division of Minneapolis-Honeywell Regulator Company. Wilson joined Honeywell in 1923. Early last year Wilson was named field sales manager for the industrial division.

J. A. Robinson has been made field sales manager succeeding Wilson. Robinson joined Honeywell in 1929. He was made industrial manager for the Eastern and Mid-Atlantic regions in 1952.

W. D. Poteet has been promoted to assistant chief engineer of Mid-Continent Supply Company, with headquarters in the Mid-Continent Building in Fort Worth. Poteet has served in the engineering department of Mid-Continent Supply Company for five years.

T. M. Cone has assumed new duties as chief engineer and manager of the engineering department at Mid-Continent. Cone has been with Mid-Continent since 1938, when he began with the company as designing engineer.

J. M. Harris of Mid-Continent has assumed new duties as specialty sales engineer in the machinery department. He has been employed with Mid-Continent for some four years as design engineer prior to his recent promotion.

Zechariah Chafee, Jr., chairman of the board of directors of Builders Iron Foundry and Builders-Providence, Inc., completed his 40th year of association with B-I-F Industries. Chafee began his service with Builders in 1907 as assistant to his father, the late Zechariah Chafee, who incorporated Builders Iron Foundry in 1853. At present, Chafee is University Professor at Harvard Law School and also does some teaching at the University of Colorado and Columbia University of Chicago.

W. J. Stanton retired December 31, 1952, as district manager of the New York office of the Spang-Chalfant Division, National Supply Company. Stanton began with Spang-Chalfant in 1932 and served at the New York office except during World War II, when he represented his company in Washington.

Richard S. Skinner, sales representative for National Supply's Spang-Chalfant division, has been transferred from the St. Louis office to Denver, Colorado, as tubular salesman. Skinner joined the Spang-Chalfant Division following his graduation from the University of California in 1937.

Roger E. Vaughan has been appointed assistant general manager of Farrel-Birmingham's subsidiary, Consolidated Machine Tool Corporation. Vaughan has been assistant general manager of the Farrel-Birmingham plant at Buffalo, New York, since 1943.

S. J. "Pat" Stowell has been appointed merchandise manager of the Kold-Hold Manufacturing Company. Stowell has recently returned from 14 months' duty with the U. S. Navy. Previously, he was district sales manager for Lonergan Manufacturing.

C. E. Smith has been named sales representative for The Western Company's Lubbock, Texas, area and **Charles Simmons** has been promoted to pumping services manager of Western's

C. E. Smith

C. M. Simmons

Panhandle-Western Kansas district. As a Western sales representative, Smith will do contact work for all company services in Lubbock, Levelland, Seagraves, Brownfield, and surrounding territory.

Simmons in his new position will direct pumping services operations of the company's stations in Borger, Guymon, Oklahoma, and Ulysses, Kansas.

F. L. Martin has been named manager of Mid-Continent Supply Company's store in Oklahoma City. Martin is former assistant store manager for Mid-Continent at the same location, and has worked for the company since 1950.

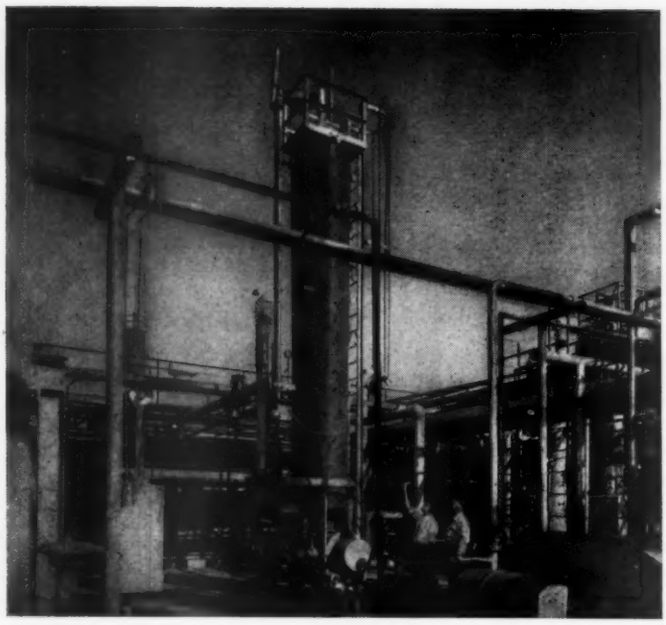
D. L. Johnston, Mid-Continent Supply district manager of diesel sales and service in Shreveport, has been promoted to Shreveport division machinery manager. Johnston has been with Mid-Continent since 1943.

E. H. Keeter, former field salesman for Mid-Continent Supply, has assumed new duties as manager of the company's store in Gainesville, Texas. Keeter has been with Mid-Continent for six years, working at Odessa and Rankin before serving at San Angelo.

R. L. Harris has been promoted to division manager of the company's Rocky Mountain division.

G. A. Metz has been promoted to division machinery manager of Mid-Continent in Casper, Wyoming. Metz has been with Mid-Continent since 1946. He worked for the organization in Odessa and Fort Worth, Texas, and in Casper as district machinery manager before his recent promotion.

Howard D. McFaddin who was field salesman at Hadacol Corners, Texas, has been transferred to Tatum, New Mexico as store manager for Continental Supply Company. **Robert D. Hoover,** former field auditor for the North and West Texas and New Mexico division, is the new manager of the Hobbs, New Mexico, store. In Louisiana, **R. A. Broussard** who was store manager at Houma has been transferred to Harvey in the same capacity. **John C. Butler,** former bookkeeper at Lake Charles, has been named store manager at Eunice, and **Edward C. Dawson** is the new manager of the Houma store after having served as field salesman there.



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THAT'S THE REPORT from a Texas plant superintendent. His 45 foot absorber tower produces 120,000 gals a day. Cleaning it used to take 4 days, with a production loss of $26,800.

Not any more. Now he just pumps a fast-acting Oakite Detergent solution through the tower and circulates it for about 20 hours. He not only gets 3 days more production—he saves $695 on cleaning costs, and gets these advantages besides:

- **No cutting-in, no dismantling of equipment**
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- **A minimum of abrading—critical dimensions remain unchanged**
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Technical Service Representatives in Principal Cities of U. S. & Canada

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MATERIALS • METHODS • SERVICE

PETROLEUM SERVICE DIVISION

Trade Personals

J. Silver

T. O. Kuivinen

J. R. Feeser

▸ **John Silver,** formerly general manager of the communications and electronics division, Motorola, Inc., is elevated to the position of vice president in charge of operations of the division. Silver joined Motorola in 1944.

▸ **T. O. Kuivinen** of The Cooper-Bessemer Corporation, has been elected to honorary Sigma XI, national honorary society. Associated for many years with Cooper-Bessemer's highly technical engineering program, Kuivinen was recently made chief engineer's assistant. He is well known throughout the industry for development of many highly technical phases of engineering.

▸ **John R. Feeser** recently joined the staff of Brown Oil Tools, Inc., Houston, as a research engineer. He will be stationed in Midland, Texas. Feeser was formerly employed by a major oil company in the West Texas area. During World War II he served with the Army Engineers.

Martin-Decker sales engineers visit Long Beach plant. Louis Webber, plant manager; Frank Crane, chief engineer; Frank Kelso, Odessa; Jack Clements, Houston; "Mutt" Donovan, Oklahoma City. Back row, Roy Boydston, California; E. L. Decker, president; Carroll Kelso, Odessa; T. J. Cullens, San Joaquin Valley.

POSITIVE OIL SHOW IDENTIFICATION with MINERALIGHT Ultra-Violet

(BLACK LIGHT)

Make sure you don't pass up possible pay! Make positive core identification checks with new model MINERALIGHT SL long wave ultra-violet lamp.

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BOOKS

Examination of Well Cuttings. *Quarterly of the Colorado School of Mines, Vol. 46, No. 4, October 1951. By Julian W. Low. Pages, 48. Price, $1.50.*

A handy references for those engaged in the analysis of ditch cuttings. Methods of testing for oil shows are listed.

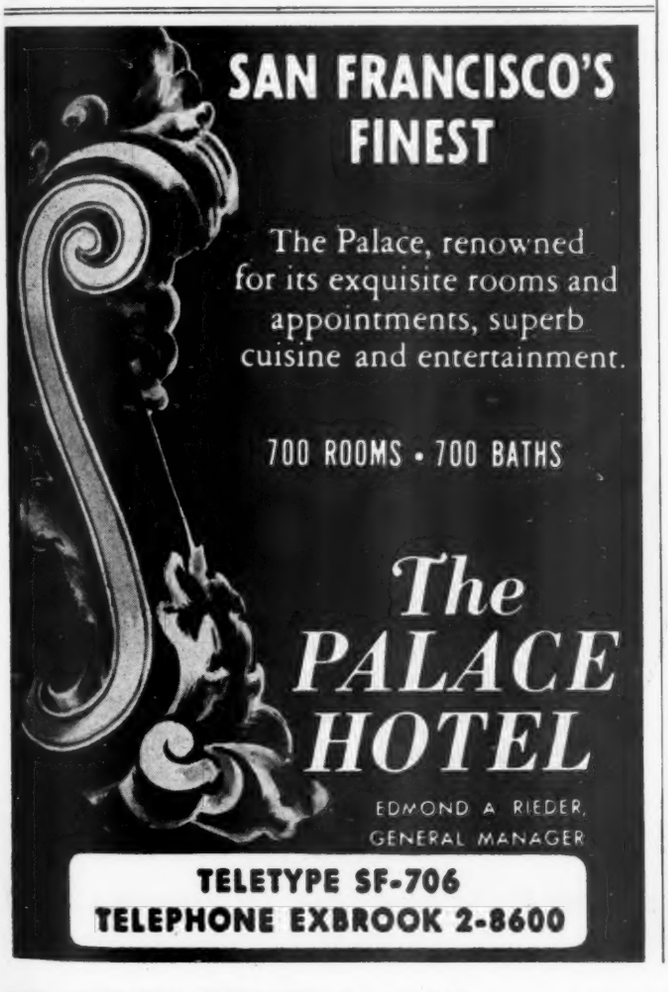
Removal of Sulfur from Petroleum Coke. *Quarterly of the Colorado School of Mines, Vol. 47, No. 3, July 1952. By Frederick K. Sabott. Pages, 36. Price, $0.50.*

The origin of sulfur in petroleum is not at all clear. An investigation was made to determine a method for reducing the sulfur content of the coke during the coking operations.

In addition, it was desired to treat the coke after its formation in a manner so as to decrease the sulfur content, and thus have a suitable raw material for production of graphite electrodes.

Boundary of the Pennsylvanian and Permian (?) in the Subsurface Scurry Reef, Scurry County, Texas. *Bureau of Economic Geology, University Station, Box B, Austin. Pages 18. Price, 30 cents.*

A publication on the Scurry reef in Scurry County, Texas, will be of interest to geologists concerned with the boundary of Pennsylvania and Permian formations in that area of Texas. This paper resulted from work on cooperative project between the Bureau and the U. S. Geological Survey, which has to do with a study of the general geology and geologic emology of reefs in Carboniferous rocks. Two of the authors, William A. Heck and Keith A. Yenne, are former U. S. Survey geologists on the project, Lloyd G. Hebest, is with the Survey, and D. H. Eargle is geologist in charge of project in Austin.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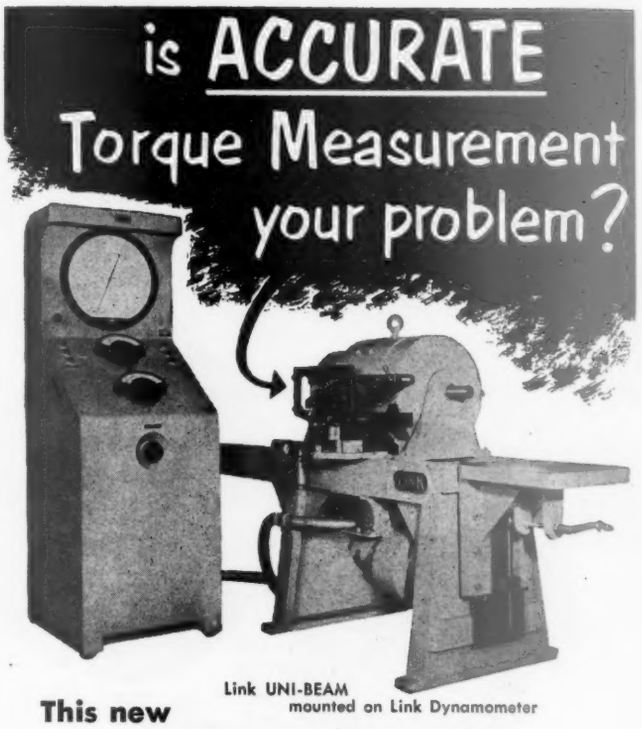

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The Uni-Beam is designed to be used for the measurement of torque reaction in either direction of rotation of a dynamometer. There's no reverse linkage. Reversing is inherent in the design itself.

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New Machinery and Supplies

Use reply card to procure promptly complete information and prices of products described here in brief.

Circle corresponding letter or letters on reply card

(A) INSPECTION INSTRUMENT

A new 50-ft cable is now available for the Sonoflux magnetic inspection instrument. This long cable greatly simplifies the problem of inspecting flanges, tubing, vessel plate and welds, furnace castings, cooling tower fan hubs, and towers in place in refinerines and chemical plants. The Sonoflux unit remains on the ground, while the operator need carry only the Sono-Probe to make inspection.

Circle letter (A) on reply card.

(B) ELECTRODE HOLDERS

A new 400-amp insulated electrode holder, the Cooltong, has been announced by Lincoln Electric Company. It is claimed that in one test made with the holder, it remained cool enough to weld with bare hands when using 400-amp current. The nose is a special "sandwich" construction consisting of a copper core between four and six layers of laminated, glass impregnated, plastic cloth.

Circle letter (B) on reply card.

(C) GENERATOR

A new dual-voltage 5 kw carryable generator has been announced by Homelite Corporation. The new generator, Model 32A115/230-1, will carry a continuous load of 5000 single-phase, 60 cycle alternating current at either 115 or 230 v. It is a carryable generator with enough power to begin and operate a great variety of electric tools and equipment. A 115-v a-c standard convenience outlet is supplied, together with a special waterproof 3-pole receptacle for connecting 115 or 230-v appliances.

Circle letter (C) on reply card.

(D) COOLING TOWER FAN

The Moore Company has announced a new fan series for cooling towers, or large heat exchangers, known as the Class 7000 Type C. Fans are provided in 2 basic sizes: Series 48, (48-in. diameter hub), and Series 72, (72-in. diameter hub). Units are provided with any number of blades, from 2 to 8.

Circle letter (D) on reply card.

(E) ODORIZER

The H and H combination drip absorption type odorizer is the latest addition to the H and H line. It needs no overflow tank because it cannot inject liquid into the main except by means of its drip lip indicator, which is always under control, the company states. The odorizing compartment is the same size for all capacities.

Circle letter (E) on reply card.

(F) ELECTRIC PLANT

An air-cooled, gasoline-powered electric generating plant has been perfected by D. W. Onan and Sons Inc. Its vacuum cooling system employs a centrifugal blower that draws cold air through the generator and over the engine, and at the same time discharges heated air out of an 8 by 12-in. side vent.

Circle letter (F) on reply card.

(G) TRANSMISSION BELTS

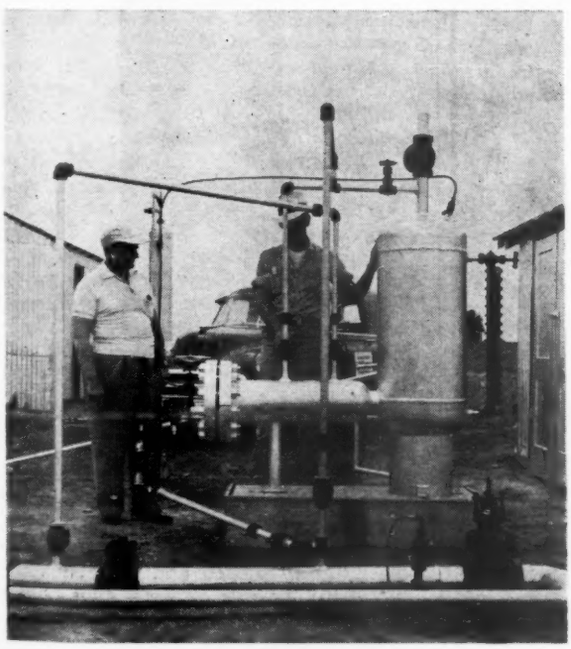
A new rubber transmission belt, developed by B. F. Goodrich, first ever made with all rayon fabric, is said to be 25 per cent stronger and has up to 10 times greater flex life than cotton fabric belts made with the same number of plies. Called "Drivesall," strength of the rayon fabric belt is due to the nature of the rayon filaments that are formed in continuous lengths.

Circle letter (G) on reply card.

(H) SHOVEL-CRANE

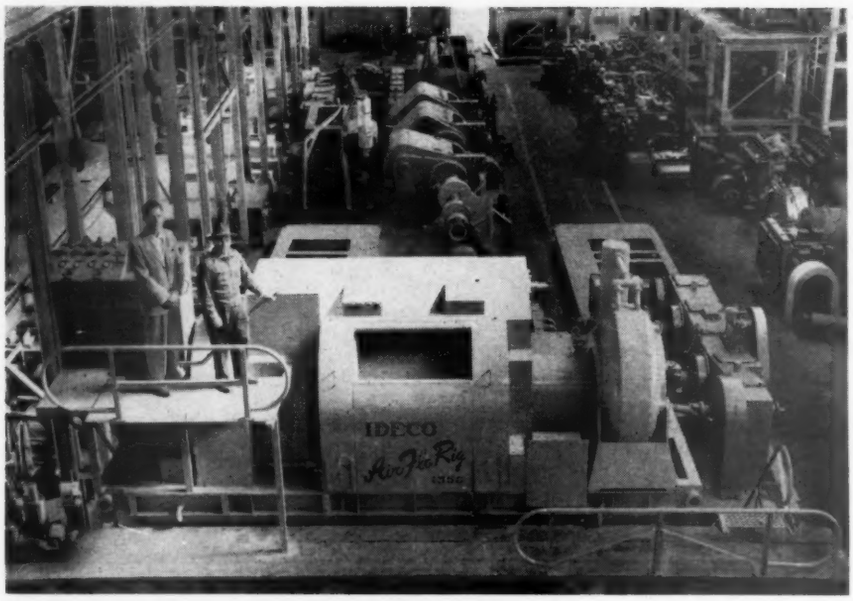
A new, truck-mounted shovel-crane, providing 20 per cent more lifting capacity than previous Bantam models, has been announced by the Schield Bantam Company. Rated at 6 tons capacity, the new ⅜-yd Model T-35 is available with matching attachments.

Circle letter (H) on reply card.



H and H drip absorption type odorizer.

Schield Bantam's truck mounted shovel-crane.



IDECO's largest torque converter equipped drilling rig.

(I) DRILLING RIG

IDECO, one of the Dresser Industries, has just completed the manufacture of what is reported to be largest torque converter equipped drilling rig in the world. Known as Model 1350-S, the giant rig features a console control panel with fingertip air controls that will put over 1785 hp to work on a drilling operation. The rig will be exported to France for use in oil fields near Pau.

Circle letter (I) on reply card.

(J) FLAME CUTTER

A new flame cutting machine, known as the Vernon "Universal' Flame Cutter is announced by Vernon Tool Company. It is a precision tool used for reworking, reconditioning, and salvaging all types of new and used welding ells, tees, flanges, reducers, etc. The manufacturer claims that the "Universal" flame cutter will cut ells to any angle, shorten ells, trees, flanges, reducers, etc.

Circle letter (J) on reply card.

Nicholson Expansion Steam Traps

SAVE $155 PER UNIT

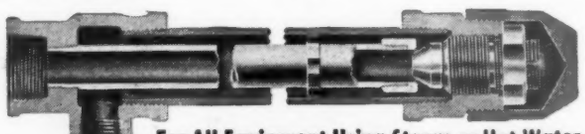
for Large Processor

Because of their positive effectiveness in temperature control work, Nicholson expansion steam traps, at about $35 each, are being installed by a leading processor in place of temperature controls. These were costing them $110 to $200, with cost of trap added. Per installation, the saving is about $155.

This firm is finding an increasing number of applications on tanks, stills, heating radiators, etc., where Nicholson expansion steam traps are serving as both trap and temperature controller.

Because there is only one moving part, remarkably low costs are being shown. Easily installed, usually without supports. Lengths, 9" to 40". Pressure 0 to 250 lbs. No air binding.

CATALOG 751



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TRAPS · VALVES · FLOATS

(K) BUBBLE CAPS

Keystone Tool Corporation has announced new bubble caps that are designed for use in all types of absorption, fractionating, distillation, and scrubbing towers. Provided with a high glaze finish if desired, the ceramic caps are precision manufactured to specifications and use the same type of hold-down pins or bolts as steel caps.

Circle letter (K) on reply card.

(L) INDUSTRIAL OVERSHOES

New neoprene rubbers designed for men who wear overshoes on the job, and especially for men who work around oils, solvents, acids, and other chemicals that damage ordinary rubbers, have been announced by E. I. du Pont de Nemours and Company. Overshoes have no fabric lining. Most noticeable advantages are lightness and comfort. They weigh only nine ounces apiece.

Circle letter (L) on reply card.

(M) TEST METER

A new frequency and modulation meter for use in the maintenance of two-way radio systems has been announced by the General Electric Company. Purpose of the new instrument is to help maintain transmitters and receivers in two-way radio systems on their assigned frequencies. The meter, type ST-13-A, measures modulation swing and carrier frequency of FM transmitters, and features both high and low RF output for receiver alignment.

Circle letter (M) on reply card.

(N) TANK SHUT-OFF CONTROL

Beaumont Iron Works Company has introduced a new tank shut-off control that is a complete package unit—including check valve—for improved tank line

performance. This shut-off eliminates air in the pump suction to reduce pump wear and loss of pump capacity. Tank discharge is started and stopped automatically. It shuts off every time at the same tank level, and works efficiently in oil of any gravity.

Circle letter (N) on reply card.

Parsons Company's new trencher.

(O) POWERED TRENCHER

The Parsons Model 88 Trenchmobile manufactured by The Parsons Company, has been tested under adverse digging conditions by excavating over 75,000 lineal feet of trench in depths up to 5 ft and from 8 to 12 in. wide. This power unit, as installed in the Parsons Model 88 Trenchmobile, develops 43.6 hp at 2000 rpm, and is highly mobile.

Circle letter (O) on reply card.

(P) POWER TAKE-OFF

Announcement of a new Model K Brown-Lipe power take-off with unusual features is made by the Spicer Manufacturing Division of Dana Corporation. Dual output capacity with two drive shafts that permit operating separate units at different intervals is a major advantage. This permits the Model K to handle such simultaneous jobs as operating gasoline and fuel oil pumps; winches and posthole diggers; pumps and lift gates, and many other double-action jobs.

Circle letter (P) on reply card.

(Q) HARD SURFACES

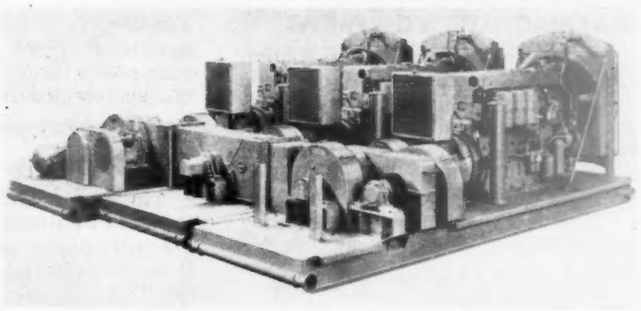
Pump parts hard-surfaced by the Sprayweld process, developed by Wall Colmonoy Corporation, are lasting from 4 to 8 times as long as new unprotected parts in oil producing and refining equipment, it has been reported. The increased life of these parts is the result of extreme wear and corrosion resistance of the fusion-bonded Colmonoy No. 6 alloy surface that is applied by the process in thicknesses from 0.030 in. to 0.045 in. The alloy surface has a low coefficient of friction that reduces packing wear and cuts down-time for pump repacking.

Circle letter (Q) on reply card.

(R) CRAWLER CRANE

A new Lorain 45-ton crawler crane has just been announced by The Thew Shovel Company. This is a companion machine to the 45-ton Lorain Moto-Crane, Model MC-824. The new model is designated as Lorain 820-KS and consists of a diesel powered turntable with hydraulic coupling power take-off mounted on a newly designed crawler. Air assist on boom hoist and crawler travel are standard.

Circle letter (R) on reply card.



National Supply's medium depth rig.

(S) PLATFORM PROTECTOR

International Nickel Company has developed a cover-up technique to protect steel pilings in tidelands drilling to support the drilling platforms against destructive effect sea water has on them. Section of the piling subject to greatest attack—the entire splash area from the low water line up to and above the maximum splash area—is covered up, by welding on to it a sheet of highly corrosion-resistant material, Monel, an alloy of nickel and copper.

Circle letter (S) on reply card.

(T) BRAKE CLUTCH

A new free-wheeling auxiliary brake clutch, the Ideal Type "A" over-running clutch, is announced by The National Supply Company. It was designed for power rigs and steam draw works equipped with hydromatic brakes. Ideal consolidated rigs of types 75-CB, 80, 100, 125, and 130, as well as steam draw works of types 34-8½ and 34-10 FE, including those now in the field, can be supplied with the new clutch. It is also available for installation on other rigs.

Circle letter (T) on reply card.

(U) DIESEL ENGINES

The Galion Iron Works and Manufacturing Company has announced that its Models 104 and 118 motor graders are now available with General Motors

2-cycle diesel engines in addition to the International Harvester diesel engines that have heretofore powered these graders.

The Model 104 grader will employ a GM 3-71 diesel engine, rated for this service at 85 hp; the Model 118 grader a 104 hp 4-71 GM diesel.

Circle letter (U) on reply card.

(V) DRILLING RIG

A new medium depth drilling rig, rated at 800 hp input, has been announced by The National Supply Company. Known as the Ideal Type 80-B rig, it incorporates all the features of the Type 80 rig, plus certain improvements. Ideal Type 80-B rig will normally be considered for drilling in the 6500 to 10,000-ft depth range. The rig is of sectionalized construction featuring a long spooling drum of optimum proportion and maximum accessibility.

Circle letter (V) on reply card.

(W) VALVES

Shand and Jurs Company has announced a new valve, described as its vapor saving breather valve. The Tite-Seal valve is said to maintain vapor tight seal at pressures and vacuums below valve settings, plus many other features. Tight seal against leakage is accomplished by balance action on which patents are pending.

Circle letter (W) on reply card.

(X) GEAR COUPLING

A new "Spacer Type" gear coupling that can be disconnected rapidly without wrenches or special tools, is announced by the Sier-Bath Gear and Pump Company, Inc. The new coupling, similar in function and general design to conventional flange-and-bolt Spacer types, makes it possible to remove the hubs from either shaft.

Circle letter (X) on reply card.

(Y) CENTRIFUGAL PUMPS

A new series of single stage, double suction centrifugal pumps, designated as the Fig. 3405 pumps, is announced by Goulds Pumps, Inc. Standard features on all the Fig. 3405 pumps include renewable stuffing box bushings, sealed bearing housings, cowl-type glands suitable for use with quenching liquids, stainless steel impeller keys, Teflon water seal rings, etc.

Circle letter (Y) on reply card.

(Z) SUPPORT HANGARS

Grinnell Company, Inc., has announced new support hangers, which offer constant support for all positions of travel for high temperature process and steam piping. This design permits 10 per cent increase or decrease in their load by field adjustment of a single bolt, without impairing their constancy. Model R constant support hangers can be bolted to the building structure.

Circle letter (Z) on reply card.

New Equipment

(AA) MAGNETIC EQUIPMENT

Announcement is made by Cutler-Hammer, Inc., of a new line of magnetic starters, contactors, and relays. This new line incorporates a simple 5-unit construction design to install easier, work better, last longer. A wrap-around cover pulls off, fully exposing the front and both sides of the unit for 180 deg accessibility.

Circle letter (AA) on reply card.

(AB) SELECTIVE SIGNALING

A single tone selective signaling system has been developed and is being produced by Motorola, Inc. The system has been designed for use in conjunction with any communication medium. Function is to allow any operator to initiate an operation at one or more remote points through an intervening communication medium.

Circle letter (AB) on reply card.

(AC) PACKERS

A new packer, the PS-3, has been introduced by Brown Oil Tools. The PS-3 is a sister packer of the Brown Duo-Pak. With the exception of a top sealing cup, the PS-3 is identical to the Duo-Pak. On shallow wells where most of the tubing weight is to be placed on the packer, the upper cup is not needed. The PS-3 can also be used to advantage when a large differential is present from below.

Circle letter (AC) on reply card.

(AD) DURAGAGE

The Ashcroft Maxisafe®Duragague combines protection to the viewer with easy entree to the entire gage movement and tube assembly for inspection, recalibration or repair, Manning, Maxwell, Moore, manufacturers, report. An integrally cast solid wall separates the dial from the gage movement and tube. A double spring-mounted safety release plate covers the entire back of the Maxisafe case. The plate permits the discharge of the pressure media away from the viewer.

Circle letter (AD) on reply card.

(AE) RUBBER GUIDE CAGES

Hycar rubber ball guides manufactured by John N. Martin, are now easily replaceable, as shown in the cut-away

illustration of open type top cage. These resilient guides cannot "beat out" and stand sand abrasion. They are made in all sizes from 1 to 4¾-in., in open and closed types and in all styles. Closed type cages are designed with stainless steel retainer band, which holds the upper portion of rubber guides in place.

Circle letter (AE) on reply card.

(AF) RELEASE VALVE

A quick-release valve has just been announced by Deublin Company. It is designed to handle air pressure from 0 to 250 psi on pneumatic clutches up to 1500 hp. According to the company, it is light weight and compact, which permits its use on rotating elements without disturbing dynamic balance.

Circle letter (AF) on reply card.

(AG) FIRE-FIGHTING ENGINE

Manufacture of a new, powerful, one-man fire-fighting wheeled engine for extinguishing large-scale B and C fires has just been announced by the American-LaFrance-Foamite Corporation.

It is a dry chemical wheeled engine, with a capacity of 150 lb. It charges free-flowing, quick-smothering Alfco dry chemical.

Circle letter (AG) on reply card.

QUACHROM GLUCOSATE*

The toughest corrosion problems in cooling water systems are readily controlled with Haering's Quachrom Glucosate*. Quachrom Glucosate* is constantly used in the Petroleum Industry to prevent unnecessary shutdowns due to waterside corrosion. Longer equipment life and lower maintenance costs result from Quachrom Glucosate* control. No other corrosion inhibitor can rival the long outstanding record of Quachrom Glucosate*.

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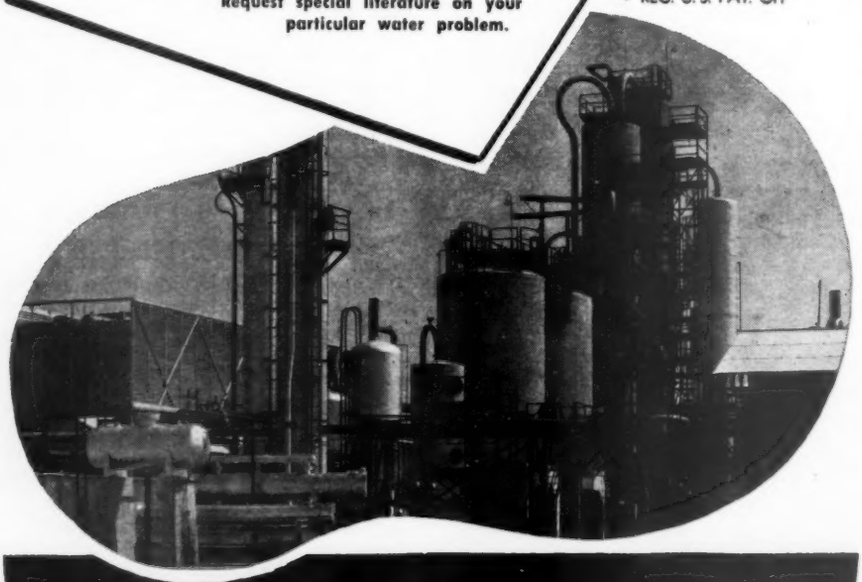

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Trade Literature

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(AH) LEVEL CONTROL

Fielden Instrument Division, Robertshaw-Fulton Controls Company, has published an 8-page folder, No. F-101, on the company's level control. This 2-color publication describes this product, outlines, applications, stresses its outstanding features (such as no moving parts or diaphragms to get out of order), and lists the various types of electrodes available.

Circle letter (AH) on reply card.

(AI) CENTRIFUGAL BLOWERS

Hartzell Propeller Fan Company has issued a new catalog, B-10, illustrating and describing the new line of centrifugal blowers. The bulletin is well illustrated with a visual index, cross sections, diagrams, and illustrative material.

Circle letter (AI) on reply card.

(AJ) ORIFICE METERS

Industrial Instrument Corporation has published three bulletins and 1 fly-leaf describing its orifice meters, orifice plates, and instrument bearings. Each bulletin is thoroughly illustrated, with a listing of features, and uses of each product. A complete listing of all IIC instruments is included.

Circle letter (AJ) on reply card.

(AK) ROTARY PUMPS

Worthington Corporation offers a new bulletin, known as W-483-B2, on heavy duty rotary pumps. Covering both the Herringbone gear type, with capacities to 5000 gpm, pressures to 100 psi; and the sliding-vane type, with capacities to 1000 gpm, pressures to 200 psi, the new bulletin is complete with fields of application, coverage charts, mountings, and dimensions.

Circle letter (AK) on reply card.

(AL) PILLOW BLOCK

Dodge Manufacturing Corporation has issued a new booklet describing the new all-steel Dodge-Timken pillow block. Studied use has been made of colorful illustrations to help bring out the features of the new product. Three pages are devoted to technical information and two pages will help the reader select the right size block for any use.

Circle letter (AL) on reply card.

(AM) LIQUID LEVEL GAGE

Jerguson Gage and Valve Company has developed a new liquid level gage, which indicates the liquid level in tanks, boilers, stills, or any containing vessel. They are used where a simply constructed, high-grade gage is desired.

Circle letter (AM) on reply card.

(AN) GAS METERS

A new 16-page booklet on meters for measuring gases of any type, and in quantities from 4000 to 1,000,000 cu ft, has been published by Roots-Connersville blower division of Dresser Industries, Inc. In addition to detailed descriptions and illustrations of meters of various types, the booklet contains a useful selection table to determine the meter required for any load, whether at standard or variable conditions of temperature and pressure.

Circle letter (AN) on reply card.

(AO) METHANOL

Commercial Solvents Corporation has published a 30-page booklet on the specifications, uses, properties, toxicology, of Methanol. It contains tables, charts, and descriptive material.

Circle letter (AO) on reply card.

(AP) BULLDOZER

A 36-page catalog of Caterpillar bulldozers and their attachments has been published by Caterpillar Tractor Company. The book is an encyclopedia on bulldozers. The catalog contains model views showing every size and style of Bulldozer made by Caterpillar and cutaway views illustrating their features. Although brief specifications are printed with each model view, two pages in the back of the book are devoted to detailed specifications of all cat bulldozers made for track and wheel-type tractors.

Circle letter (AP) on reply card.

(AQ) CAST STEEL

Edward Valves, Inc., has announced publication of a new 56-page catalog covering their cast steel valves. Included is complete information on globe, angle and check valves in 300, 600, 900 and 1500-lb pressure classes. Parabolic disk valves for hand or motor control of volume are also described in detail. The new booklet contains complete information on material specifications, preparation of welding ends, etc.

Circle letter (AQ) on reply card.

(AR) VAPOR ILLUMINATORS

Jerguson Gage and Valve Company has published a 1-page leaflet on its mercury vapor illuminators for steam gages. This new instrument is said to permit the taking of accurate gage readings of the boiler water level . . . over longer instances, through dust particles in the air or deposits on the gage glass, or in poorly lighted areas. When a gage is equipped with the Jerguson mercury vapor illuminator water column shows blue-green, topped with an intensely brilliant emerald green spot at the water level, to give an unmistakable water level indication.

Circle letter (AR) on reply card.

(AS) GAS ENGINES

Publication of a new four-page, two-color bulletin describing the design, construction, and operating features of Nordberg FSE-9 and FSE-13 spark-fired gas engines is announced by the Nordberg Manufacturing Company. Nordberg four-cycle spark-fired gas engines, as discussed in Bulletin 221, are built in 9 and 13-in. bore sizes and range from 265 to 4260 hp.

Circle letter (AS) on reply card.

(AT) WIRE ROPE

A new 64-page handbook on Leschen slings and fittings is now available from the A. Leschen and Sons Rope Company. It is printed in a handy 4¾ by 6½-in. size for convenient reference on the job or in plant offices. It contains more than 100 illustrations, showing standard wire rope slings, grommet slings and multiple part slings, the latter including flat-laced, hand-braided slings.

Circle letter (AT) on reply card.

(AU) INDUSTRIAL WASTE

How large sewage pumps are motorized and their function in eliminating pollution of San Francisco Bay and Boston Harbor is told in two feature articles of E-M Synchronizer No. 38, the sewage works number, just released by Electric Machinery Manufacturing Company. A third highly informative article written by a professor of sanitary engineering in one of our country's leading technical colleges describes how strange animals and plants take part in resolving filth into purity.

Circle letter (AU) on reply card.

(AV) PRESSURE VESSELS

An evaluation of the properties of weld metals for low-temperature service is featured in the Winter 1953 issue of the Alco Products Review. The paper discusses materials used in the fabrication of pressure vessels for low-temperature service, the investigation of ferritic electrodes to determine the properties of deposited weld metals for low-temperature service, and the Charpy notched-bar properties of weld metals at various temperature levels.

Circle letter (AV) on reply card.

(AW) GEAR DRIVES

Helical gear drives—their advantages, fields of application and correct selection—are discussed in a new, illustrated 16-page Book No. 2451, just released by Link-Belt Company. Full-page cross-sectional views show in detail the design and construction features of both the double and triple reduction types. Installation photographs picture typical installations.

Circle letter (AW) on reply card.

(AX) CORROSION INHIBITOR

Cardinal Chemical, Inc., offers detailed information on a new and greatly advanced corrosion inhibitor Nocor "102," which utilizes radically different chemi-sorptive powers to form a tighter, more impervious film.

Circle letter (AX) on reply card.

Kingdoms have been lost because of the lack of minute, special equipment at a critical time.

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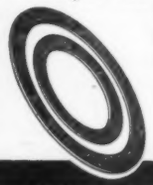

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(AY) CHEMICAL EDUCATION

Handbook for Chemistry Assistants, a unique 32-page manual prepared and published by a committee of the division of chemical education of the American Chemical Society. For young, inexperienced teachers the new *Handbook* brings detailed, easy-to-read chapters on conducting a recitation period; conducting a laboratory period; quizzes, tests, reports, safety measures, and first aid procedures, among others.

Circle letter (AY) on reply card.

(AZ) RUST PREVENTIVE

Just released by the Rust-Oleum Corporation is this new 1953 general catalog with 16 pages devoted to showing how Rust-Oleum stops rust throughout industry. The new catalog, featuring 73 color chips of Rust-Oleum products, includes complete instructions for surface preparation and application of Rust-Oleum primers, short oil type, long oil type, machinery and implement finishes.

Circle letter (AZ) on reply card.

(BA) TRENCHLINER

Parsons' improved Model 250 Trenchliner is fully described in a new 16-page catalog, illustrated to show in detail some of the exclusive Trenchliner features that provide greater production speeds and more versatile trenching operation. Parsons is a subsidiary of the Koehring Company of Milwalkee. Maximum digging capacities of the Trenchliner are 12½ ft deep, 16-42 in. wide.

Circle letter (BA) on reply card.

(BB) NEEDLE VALVE

Specifications and dimensions of The Lunkenheimer Company's new gland-type needle valves are graphically described in a new, two-color illustrated circular. These precision needle valves are applicable to instrument lines, orifice meters, gages, by-passes, etc. Circular shows wide selection of gland-type needle valves made by Lunkenheimer.

Circle letter (BB) on reply card.

(BC) PIPE LINE WRAP

A 6-page folder on Trantex tape, a new cold-applied pipe line wrap developed by Johns-Manville for corrosion protection for underground gas and oil pipe lines and overhead piping is now available. This folder is designed to be a source of ready-reference data for corrosion engineers, operations engineers, maintenance departments of oil and gas transmission lines as well as gas distribution companies, process industries.

Circle letter (BC) on reply card.

(BD) RADIO LINKS

Economic aspects of multi-channel operation of telephone and telegraph circuits over microwave radio links are emphasized in new Lenkurt Bulletin 72A-P16, Microwave in the Telephone Toll Plant. Among the subjects discussed in this publication are the investment required for microwave equipment, the revenue possibilities that microwave provides.

Circle letter (BD) on reply card.

(BE) INSTRUMENT TRANSFORMER

The 1953 edition of the G-E instrument transformer Buyer's Guide contains basic, up-to-date information on the complete General Electric line. The fully illustrated, 102-page publication, GEA-4626F, contains ratings, ASA accuracy classifications, and prices of all G-E indoor and outdoor potential and current transformers.

Circle letter (BE) on reply card.

(BF) PIPE LINES

"Pipeline to Profit" is the name of a new booklet published by Caterpillar Tractor Company. The eight-page booklet carries out an imaginary "pipe line to profit" by using pictures and captions to explain various steps in a pipe line project. Pictures in the booklet include some taken on lines being constructed by Wunderlich Griffis Construction Company, Anderson Brothers Corporation, R. H. Fulton and Company, etc.

Circle letter (BF) on reply card.

(BG) VALVES

Bulletin 1000, describing and illustrating the complete line of Ledeen valves, is now ready for distribution. The bulletin includes illustrations, operating and circuit diagrams, and dimensions and weights. Ledeen valves, embodying disc type construction, are used for operating air and hydraulic cylinders, single and double acting, and air motors.

Circle letter (BG) on reply card.

(BH) INSTRUMENT TUBING

A new bulletin on corrosion-proof Dekoron instrument tubing is announced by Samuel Moore and Company. The bulletin describes the several different kinds of corrosion-proof Dekoron tubing: Dekoron instrument tubing, single-line metal tubing with plastic sheath; Dekoron Impervapak Metl-Cor, multiple metal harness with polyethylene coating; and Dekoron Impervapak Poly-Cor, multiple polyethylene tube harness with vinyl sheath.

Circle letter (BH) on reply card.

(BI) SHOVEL-CRANE

Publication of a colorful 24-page catalog describing its 51 series shovel-cranes has been announced by the Link-Belt Speeder Corporation. The fully illustrated catalog No. 2428 covers Link-Belt Speeders complete line of ½-yd shovel-cranes including the firm's crawler-mounted LS-51, the truck-mounted HC-51 and the wheel-mounted MS-51 models.

Circle letter (BI) on reply card.

(BJ) PROTECTIVE COATINGS

Pittsburgh Coke and Chemical Company has prepared a series of five free bulletins describing the firm's Pitt Chem 100 series of tar base protective coatings. One bulletin gives specifications, uses, and methods of applying all four coatings in the series. Other bulletins give detailed information on each of the coatings in the series.

Circle letter (BJ) on reply card.

(BK) MECHANICAL SEAL

A new all-purpose mechanical seal has been announced by the Crane Packing Company. Known as the "John Crane" Type 19, the seal is said to provide life-time performance in small pumps, hot water circulators, and many other rotary shaft applications. Special beveled cones made of Teflon (du Pont trademark for tetrafluoroethylene resin) are utilized as the flexible member.

Circle letter (BK) on reply card.

(BL) V-BELTS

A new 8-page, 4-color, catalog on V-belts for industrial use is available from Thermoid Company. New simplified conversion tables are a feature of this publication whereby a user can determine, more quickly and easily than ever before, the correct Thermoid belt to replace the belts of other manufacturers. Prices, dimensions, weights and construction details are also presented.

Circle letter (BL) on reply card.

(BM) ROLLAWAY PUMPS

An 8-page folder (Bulletin 160-26) describing the complete line of Pioneer and rollway pumps including latest models added to the line is now available from Pioneer Pump and Manufacturing Company. Pioneer centrifugal pumps for coolants, cutting oils, etc., are illustrated, with numerous line drawings and photographs of typical installations on many types of machine tools.

Circle letter (BM) on reply card.

(BN) COUPLINGS—TORQUES

Twin Disc Clutch Company has released a 32-page special issue of Production Road, titled "Coupling or Converter?" The new "Coupling or Converter?" issue uses layman's terminology to acquaint the reader with the meaning and characteristics of torque and the effect torque has on both driving and driven equipment.

Circle letter (BN) on reply card.

(BO) UTILITY BLOWER

Belt-Drive utility blowers in sizes from 9 to 30-in. are among the new centrifugal blower units that have been added to the Hartzell Propellor Fan Company's complete line of propeller-type fans and blowers. Detailed specifications and complete air delivery tables for the new blowers are included in Hartzell's new blower catalog B-10. The belt-drive blowers are equipped with an adjustable motor pulley.

Circle letter (BO) on reply card.

(BP) TRENCHER

A new 4-page bulletin on the Cleveland Model 320 trencher has just been published by the Cleveland Trencher Company. Performance-proved on thousands of miles of pipe lines throughout the world, this Cleveland model has become an outstandingly popular pipe line trencher during the four years it has been on the market. The folder contains many photographs presenting the 320 in action.

Circle letter (BP) on reply card.

(BQ) WELDING ACCESSORIES

Welding division of A. O. Smith Corporation of Milwaukee has just issued a welding accessories catalog that offers customers a complete line of such accessories and makes ordering and shipment a vastly speeded operation. The welding accessories line in an innovation of the past half year.

Circle letter (BQ) on reply card.

(BR) DRILL PIPE

Spangweld and Spang double seal shrink thread drill pipe and tool joints are presented together in a new 24-page, 4-color, 8½ by 11-in. booklet by Spang-Chalfant, division of The National Supply Company. The new brochure, Bulletin No. 385, outlines the principal problems of drill pipe use and lists steps taken toward their solution by development of these two types of drill pipe, etc.

Circle letter (BR) on reply card.

(BS) CORROSION BOOKLET

Nickel Information Service has published an 8-page booklet titled "Effects of Velocity on Corrosion by Water," containing 12 charts, tables, and illustrations. A general review of 56 technical articles and pertinent unpublished data with emphasis on iron, zinc, copper, and their alloys is included. Where nickel alloyed irons, stainless steels or cupro-nickel behave more beneficially the comparison is presented.

Circle letter (BS) on reply card.

(BT) CORROSION PROTECTION

A new illustrated brochure designed to help solve corrosion problems has just been released by the Tapecoat Company. The brochure presents practical suggestions to combat corrosion. It includes details on how and where coal tar protection can be used to best advantage and offers case histories to show how corrosive problems have been overcome.

Circle letter (BT) on reply card.

(BU) INSULATION SPECIFICATION

Johns-Manville has just issued the attached 52-page brochure entitled, "Johns-Manville Insulation Specifications for Oil Refineries and Chemical Process Plants." It is designed as a quick reference for engineers and others who must specify thermal insulations in these industries. Specifications are written for economy of operation, better control of process temperatures and for the safety of both personnel and equipment.

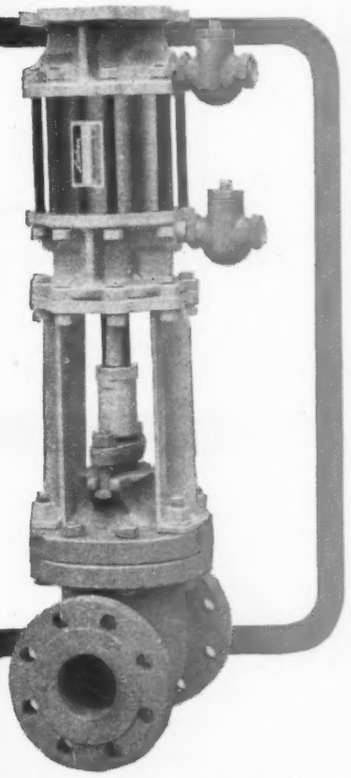
Circle letter (BU) on reply card.

(BV) POWER CRANES

A series of eight articles discussing the "Use and Application of Power Cranes and Shovels" has been compiled under one cover by the Koehring Company of Milwaukee and made available for general distribution. The articles originally were written by E. O. Martinson, Koehring Company, vice president in charge of engineering. As indicated by the title, the 32-page booklet contains a detailed discussion on the basic principles of power shovel operation.

Circle letter (BV) on reply card.

Ledeen
VALVE
ACTUATORS



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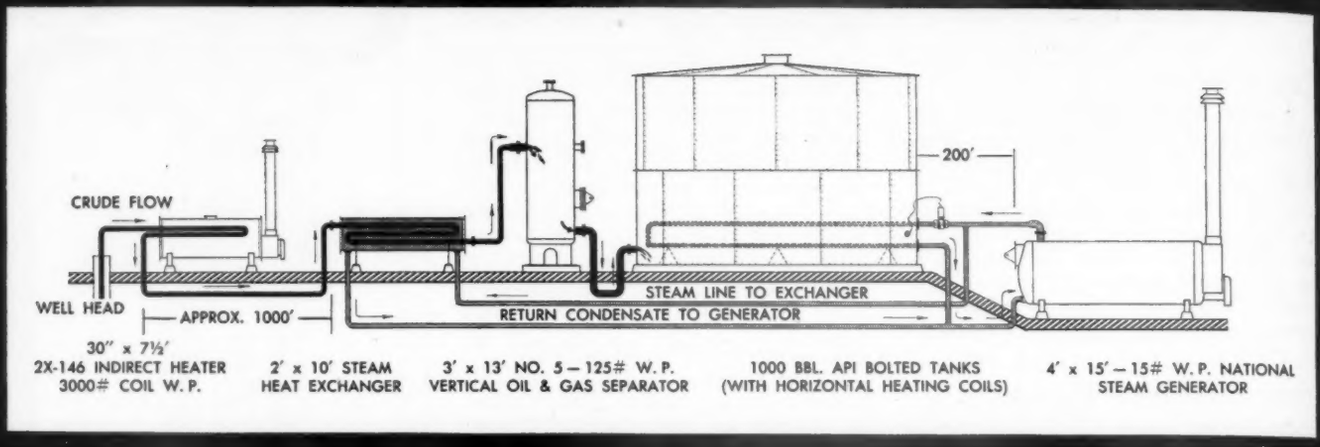
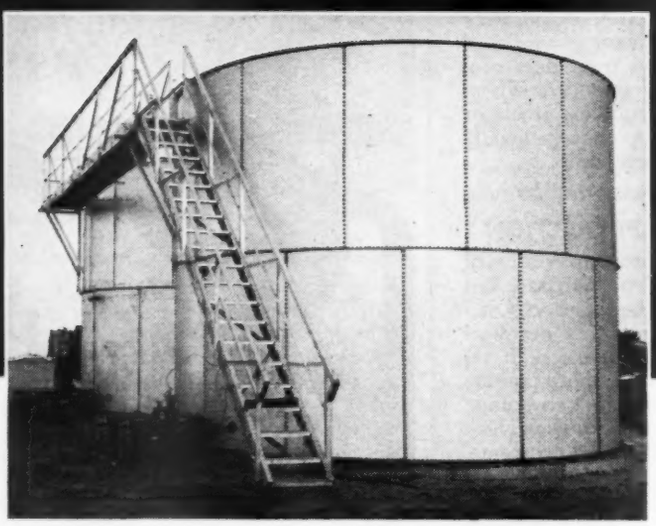
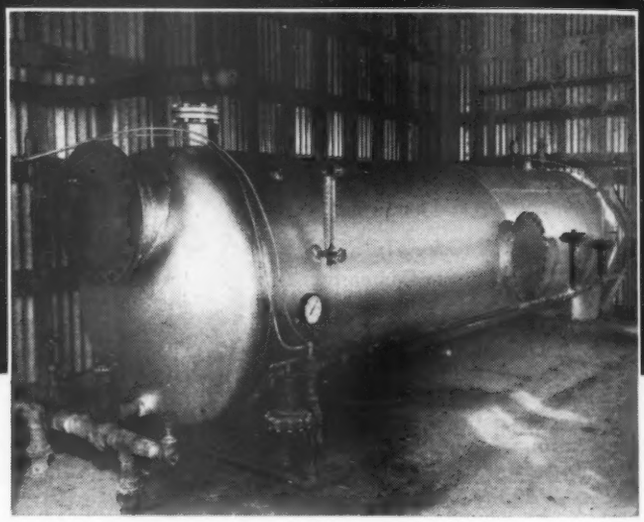
Problem — To handle 240 barrels per day of 37-degree gravity oil with a pour point of 90-degrees.







Solution — National Tank Company equipment is set as per the above flow diagram. An indirect heater is set at each well head for a flow line heater in order to keep production at a high enough temperature to prevent congealing in the lines. Before separation, the production is subjected to an additional heat through a Steam Heat Exchanger so that gas can properly be separated from the oil in the oil and gas separator. Each tank is thermostatically controlled at a temperature of 110° preparatory to being shipped by truck as there is no pipeline connection available at present time. A 4' x 15' two million BTU 15# W. P. National Steam Generator is installed along with coils in each tank to keep the production to 110-degrees in the stock tanks. This is a closed system with the generator set at a lower level than the tank grades and the condensate line buried from the tanks back to the unit. Atmospheric temperatures in this area range sometimes as low as 40° below zero in the winter months.

It's a National

NATIONAL TANK COMPANY

TULSA, OKLAHOMA